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BRIEFLY TOLD.

NOTES.—

MR. JAMES B. GRIMWOOD, Secretary of the Pacific Coast Gas Association, has resigned from the service of the California Gas and Electric Corporation to accept a responsible place with the California Engineering and Construction Company, with headquarters in the Rialto Building, San Francisco, Cal. May good fortune accompany him.

A CORRESPONDENT writes that Mr. W. A. Armington, the representative of the Consolidated Industries Company, of New York, which concern has control of the plant and business of the Consolidated Gas and Electric Company, of Batavia, N. Y., has been informed that his appointment of Mr. E. A. Wakeman as General Superintendent has been confirmed by the home office. Mr. Armington announces that while he will spend some time in Batavia, Mr. Wakeman will have complete charge of the operation of the gas and electric works. It is further said that the improvement work in connection with the plant will be hurried to completion.

AT the annual meeting of the Buffalo (N. Y.) Gas Company the Directors elected were: Alex. C. Humphreys, Robt. L. Frazer, J. Edward Addicks, Robt C. Pruyn, F. D. Locke, H. Seligman, H. L. Clark, Stephen Peabody, George Wharton Pepper, Pascal P. Pratt, Wm. S. Riselay.

THE National Gas Register Company, to do business in Grand Rapids, Mich., has been incorporated by Messrs. W. H. Silcox, Reuben W. Adler, J. V. Allen and G. T. Gamble, all of Grand Rapids. It is capitalized in $25,000.

WORK on the Menonimee Valley plant of the Milwaukee Gas Light Company is progressing satisfactorily. General Manager E. G. Pratt is confident that the plant will be completed by December 20th.

THE San Francisco daily papers of recent date are our authority for the statement that an opposition concern to the San Francisco Gas and Electric Company is being promoted. Think of it; after the gas history of that city for the past 5 years!

A USEFUL addition to our library is a well put together book entitled "Acetylene: The Principles of its Generation and Use." It was prepared, compiled and arranged by F. H. Leeds, F.I.C., F.C.S., the well-known London Chemist acting in conjunction with W. J. Atkinson Butterfield, M.A., F.I.C., F.C.S., also an English chemist of world-wide renown. In fact the latter is well-known to gas men from his excellent work entitled "The Chemistry of Gas Manufacture." The volume in every way answers to the claims of its authors that it is a practical handbook on the production, purification and subsequent treatment of acetylene for the development of light, heat and power. Messrs. J. B. Lippincott & Co., of Philadelphia, have the American rights for the work.

THE new Board of Trustees, of the Consumers Gas Trust Company, of Indianapolis, Ind., is as follows: John P. Frenzel, Fred. Fahnley, A. A. Barnes, Bement Lyman, John E. Scott, Henry C. Atkins, W. J. Richards, James W. Lilly and Harvey Bates, Jr. Meanwhile, the odd warfare that is being carried on by the Indianapolis *News* against those

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who control the gas supply of that city is dragging on without any particular glory or fame to those who are directing the shots from the editorial rooms of the *News*.

HERE'S the latest about the gas bill: "A resident of Philadelphia, who has a passion for reading the out-of-town newspapers, and also for answering many of the advertisements he finds in them, tells this on himself. The other day he answered an advertisement in one of the New York newspapers, stating that for one dollar a method of saving gas bills would be sent. In two days he received a printed slip by mail which read, 'Paste them in a scrapbook.'"

MR. JAMES WHITE has resigned his position as Superintendent of the electrical department of the Waltham (Mass.) Gas Light Company. He first took service with the Company in 1889.

THE Detroit City Gas Company has issued a general mortgage in the sum of $10,000,000, the Trustee being the Equitable Trust Company, of New York. The mortgage was really made July 24, 1903, but the deeds were not filed until the 2d inst.

Obituary Note—Prof. Robert H. Thurston.

We are indebted to a contemporary for the facts respecting the death of Professor Robert H. Thurston, Director of Sibley College, Cornell University, N. Y., who passed away Monday, the 26th prox. It was the 64th anniversary of his birth, and to celebrate the event he had invited Dean Huffcut of the College of Law, Professor Hewitt, Andrew D. White, former President of the University, and others to be his guests at dinner. He had been in apparent good health, and had just returned from a walk. He seemed to fall asleep, but when his wife tried to rouse him it was found that he was unconscious, and he died before a physician could be called. Professor Thurston was born in Providence, R. I., and received his early training in the shops of his father, who was a well known mechanical engineer. He pursued the scientific course at Brown University, from which he was graduated in 1859. After two years with his father he entered the navy as third assistant engineer. During the Civil War he served on several vessels, and was with both the North and South Atlantic squadrons. Afterward he was appointed Assistant Professor of Natural and Experimental Philosophy at the Naval Academy at Annapolis. He visited and studied the iron manufacturing establishments of England, and in 1872 resigned from the navy with the rank of first assistant engineer. One year before this he was called to the professorship of Mechanical Engineering at Stevens Institute. This chair he occupied until 1885, when he went to Sibley College as director and as professor of mechanical engineering.

Professor Thurston was a member of several United States commissions, among others the commission to the Vienna Exposition in 1873, where he served on the international jury and edited the "Reports of the United States Commissioners." He was also a member of the board to test metals and the board to investigate boiler explosions. He was the first President of the American Society of Mechanical Engineers and a liberal and valued contributor to its transactions. He was a frequent attendant at the meetings, the pleasure and profit of which were greatly enhanced by his pleasing address and deep and accurate knowledge. He was Vice-president of the American Association for the Advancement of Science in 1877 and 1884, and also of the American Institute of Mining Engineers in 1878.

Professor Thurston occupied a prominent place as an inventor, designing a steam engine governor, a device for testing lubricants, an autographic testing machine and many other appliances. He was a liberal contributor to the scientific press, and an always welcome speaker before scientific and other societies. Among his published works are the following:

"A Manual of Steam Boilers—Their Designs, Construction and Operation;" "Friction and Lost Work in Machinery and Mill Work;" "Animal as a Machine and Prime Motor and the Laws of Energetics;" "Handbook of Engine and Boiler Trials and the Use of the Indicator and the Prony Brake;" "Handy Tables for Laboratory Computations;" "Manual of the Steam Engine—Part I, History, Structure and Theory; Part II, Design, Construction and Operation;" "Materials of Engineering—Part I, Non-metallic;" "Materials of Engineering—Part II, Iron and Steel;" "Materials of Engineering—Part III, Brasses, Bronzes and Other Alloys;" "Reflections on the Motive Power of Heat (Carnot);" "Stationary Steam Engines;" "Steam Boiler Explosions in Theory and in Practice;" "Text Book of the Materials of Construction;" "History of the Steam Engine."

The Policy of Gas Enrichment (Illustrated by London Practice).

[A paper prepared for the Thirty-first Meeting of the American Gas Light Association (Detroit, Mich., Oct. 21st, 22d, 23d), by MR. ARTHUR GRAHAM GLASGOW, London, England.]

Prefatory Note.—The author has added the above bracketed phrase to his title, because he believes that greater interest will attach to this statement if the general consideration of the subject be supplemented by specific figures showing the value *versus* the cost of enhanced quality; and the present London situation offers opportune facilities for such specific comparison.

The three London Gas Companies (each of which has a separate and distinct district) were formerly required to supply gas giving the luminosity of 16 standard candles, when burned in the "London" Argand at the rate of 5 cubic feet per hour.

In 1900 the South Metropolitan Gas Company sought and obtained Parliamentary sanction to supply gas of 14-candle power (when reduced to 5 cubic feet hourly), tested at 16 candles luminosity, *i. e.*, when burning at the rate of 5.7 + cubic feet per hour.

The Commercial Gas Company obtained similar rights in 1902-3, leaving the Gas Light and Coke Company (supplying about 60 per cent. of the London consumption) as the sole Metropolitan purveyor of 16-candle power gas.

The witnesses employed by the South Metropolitan and Commercial Gas Companies, in support of their 14-candle power standard, so decried the value and proclaimed the evil of the additional 2 candles luminosity, that the London County Council (originally opposed to the reduction in quality) promoted an amendment in the Session of 1903 to compel the Gas Light and Coke Company, *inter alia*, to adopt a 14-candle power standard, with a compulsory reduction of 2d. per 1,000 cubic feet in the price of gas. Unfortunately, this amendment was withdrawn, owing to concessions by the Company in other directions, and the opportunity of ventilating this question in Parliament was lost.

The South Metropolitan Gas Company and its allied Commercial and Crystal Palace Companies have formulated a Parliamentary case for low grade gas with zeal and even with vehemence, but no gas undertaking has yet been required to traverse its arguments and establish the case for enrichment. For that reason the author is encouraged to offer this small contribution to the common knowledge.

As destruction is easier than construction, so it would be, perhaps, easier to destroy the fabric of evidence erected in support of the reduced standard than to specifically measure the advantage of supplying the higher quality of gas; nevertheless, the latter task appears to present so little difficulty that it is attempted within the limit of this communication.

An intelligent discussion of gas enrichment manifestly requires a preliminary understanding of the various

Methods of Enrichment.—The question of coal gas enrichment began to assume an acute stage in the United Kingdom more than 15 years ago, owing to the diminishing supply and increasing price of cannel. If the use of cannel were the only mode of enrichment now available, the great majority of gas consumers would unquestionably be better served by unenriched coal gas, of the natural quality produced by the most available gas coals. Cannel enrichment is generally played out; the candle is not worth the game.

The "vapor-enrichment" of coal gas is an unreliable makeshift, designed to satisfy official tests rather than as a means of practically benefiting the consumer. As usually applied, this method consists in injecting hot vapor of benzol into the gas as it enters the distributing system, but whether any of this condensable vapor reaches the consumer depends upon conditions over which the gas manager has no control.

A consideration of the nature of benzol will indicate the essential defect in this method of enrichment. Commercial 90 per cent. benzol is a liquid mixture of benzene (C_6H_6), toluene (C_7H_8), xylene (C_8H_{10}), etc., of the aromatic series (C_nH_{2n-6}). Its specific gravity is about .880, and its initial boiling point about 180° F. Ninety per cent. of the mixture distils below 212° F. Below 180° the natural condition of this benzol is liquid, just as below 212° the natural condition of water is liquid. Above 180° it begins to volatilize, and at 212° is 90 per cent. vapor, just as steam is aqueous vapor. If the temperature be subsequently reduced below 180°, the benzol vapor will again become liquid, just as steam will again condense to water below 212°. In other words, benzol cannot exist in the form of permanent gas, but becomes partially vaporous or entirely liquid according as the temperature is above or

below 180° F. Thus the attempt to supply the consumer with substantial enrichment, by injecting hot benzol vapor into the gas leaving the works, is somewhat akin to an endeavor to supply him with heat by admitting steam to this issuing gas.

But just as air may contain aqueous vapor to a degree of humidity known as the point of saturation or "dew point," so any gas may be saturated with benzol vapor. This amount of enrichment may be regarded as permanent so long as the temperature is not lowered. The "dew point," however, depends absolutely upon the temperature. If gas, saturated at one temperature, be subjected to further cooling in the distributing system, a corresponding deposition of enriching vapors will ultimately take place, just as dew condenses after sunset.

Now unenriched coal gas is already saturated with benzol and co-solvent hydrocarbons to a degree dependent upon the method of condensing, and the co-ordination of temperatures during manufacture, storage and distribution. Such gas frequently contains 95 per cent. of the total benzol produced during the distillation of the coal. Therefore, to inject any considerable additional quantity of artificially heated benzol vapor into the outlet gas creates an excess load which the gas cannot permanently carry, although some of this surplus vapor may be kept suspended in a state of fog during its travel through the trunk mains and larger arteries.

Sir George Livesey, in his paper on "The Enrichment of Coal Gas," May, 1900, gave the following experience of vapor enrichment:

"Reliable evidence as to its want of efficiency is furnished by the fortnight's experiment in 1894, when all of the South Metropolitan Gas was sent out unenriched, and the succeeding fortnight, when it was enriched with spirit as usual. The tests by the portable photometer were practically the same in both cases. The portable photometer results—although, as an instrument, it corresponds exactly with the official photometer—cannot be accepted as accurate, because the instrument is used under improper conditions. Still, when compared with itself under similar conditions (as in these two series of tests), the comparison holds good. Therefore, if this complete practical experiment gave, as is believed, reliable results, the conclusion is inevitable that enrichment by spirit vapor is useless, and simply a waste of the consumers' money."

This emphatic declaration of the Chairman of the South Metropolitan Gas Company is corroborated by recent Parliamentary evidence of Dr. Frank Clowes, Chief Chemist and Superintending Gas Examiner to the London County Council. Dr. Clowes stated that his special tests of South Metropolitan gas, as it reached various important consumers, averaged 14.68 candles under the former 16-candle standard and 14.26 candles under the present 14-candle standard; whereas, according to the Company, the works and official tests during the same period averaged:

	Works.	Official.
Half year to June, 1901.....	16.77	16.58
" " 1903.....	14.70	14.75

It may be added that even the scant half candle difference found by Dr. Clowes cannot be credited to the vapor enrichment, inasmuch as the natural coal gas was made in smaller volume per ton, and consequently of higher quality, when the higher standard was in force.

This ineffectual vapor enrichment cannot, therefore, be accepted as a practical substitute for cannel enrichment. Hence those that will recognize no other alternative are correct, within their limitations, when they compound with Parliament for the abolition of enrichment; and Parliament within similar limitations, is justified in abolishing a system of enrichment whereby it is admitted that the consumer pays for goods that are not delivered. It is evident, however, that such cases are an argument not against enrichment, but against *the failure to enrich.*

Broadly speaking, there is now but one intelligent method of enriching coal gas, namely, by the admixture of carburetted water gas of higher quality. Therefore, it may be well to recite some of the special features of that product and process, even at the risk of being considered elementary.

Carburetted Water Gas.—Chemically there is no such gas as carburetted water gas or coal gas. These are commercial terms designating the products of two industrial processes, each yielding a complex mixture of a number of individual gases. Furthermore, in spite of the different apparatus, processes and raw materials employed, there is no appreciable difference in the *qualitative* analyses of these two products. That known as carburetted water gas contains only the elements present in coal gas, and the two products may be mixed in any desired proportion to form an intermediate product, quite as homogeneous as either of the two originals and with quite as much right, chemically, to a distinctive name. In other words, the names serve to distinguish the dissimilar methods of production rather than the manufactured products.

Essential Features.—In considering enrichment by carburetted water gas, three essential features must be first grasped:

(a) Carburetted water gas is not only a means of enrichment, but is a salable gas, in every respect as suitable as ordinary coal gas for general distribution *per se.* Simple enrichment of otherwise finished coal gas necessarily means additional expense; whereas the admixture of carburetted water gas displaces an equal bulk of coal gas. If this enriching water gas be as cheap as the unenriched coal gas, the cost of the enrichment is *nil*, compared with the coal gas *per se.*

(b) Unlike coal gas, the higher the candle power of carburetted water gas—within the practical limit of say 35 candles—the cheaper is its cost per candle. On this feature depends its peculiar facility for enriching coal gas by admixture therewith.

(c) The joint manufacture of carburetted water gas and coal gas results in striking reflex economies in the cost of the *coal gas*, through what are known as the "collateral" economies of the carburetted water gas.

Collateral Advantages.—These collateral advantages of carburetted water gas may be summarized as follows:

1. Saving in first cost of works. Excluding the distributing system, but including storage holders, the cost of large carburetted gas works *per se* is about two-fifths of that of coal gas works. When auxiliary plant is dove-tailed into existing coal gas works, the relation is more favorable to carburetted water gas.

2. Small ground space occupied. The space needed for carburetted water gas *per se* is about one-third that needed for coal gas works. But when carburetted water gas plant is installed as an auxiliary in coal gas works, no facilities are needed for receipt and storage of fuel, and the displacement and consumption of coke usually save coke storage space sufficient for the generating plant.

3. Wear and tear. This total expense is about 1½d. per 1,000 cubic feet of carburetted water gas, compared with 3½d. in coal gas manufacture.

4. Availability. In case of need, reserve plant is immediately available, contrasted with the several days needed to bring coal gas benches into action, and the ensuing expensive repairs. The plant can be brought, without injury, from a cold state into full efficiency in 3 hours. It can be kept under slow fire without appreciable expense, and can then be in free use within the hour. By thus taking up inequalities of consumption, and meeting emergencies otherwise borne by the retort house, the process diminishes the repair charge for coal gas and reduces the necessary gasholder capacity. Reserve plant for the same daily volume usually costs less than holder and tank, and meets a prolonged demand with a continuous profit-earning supply, whereas an emptied holder is unproductive.

5. Increased prices for coke. By creating a demand on the works for coke issuing from the retorts, checking the production of coke in proportion to the coal gas displaced, and avoiding labor and losses of stacking and handling.

6. Approximate independence of coal supply. The surplus coke from each 1,000 cubic feet of coal gas produces about 3,000 cubic feet of carburetted water gas; in other words, the make per ton of coal carbonized may be increased from 10,000 to 40,000 cubic feet.

The use of carburetted water gas enables the illuminating power of the coal gas to be sacrificed for a greater yield per ton of coal, and thus reduces the cost of the coal gas per 1,000 cubic feet. In the same way, it affords free choice of gas coals, and relatively increases the gas coal supply by reducing the demand.

The importance of the two preceding features is illustrated by the following British figures: The present consumption of gas coal in the United Kingdom—about 14,000,000 tons per annum—would be increased one-seventh, or 2,000,000 tons annually, if it were not for the auxilliary manufacture of carburetted water gas. In view of recent coal markets, it is impossible to estimate the results with gas coals if this increased demand had existed; but it may be stated that, with an average of 33 per cent. carburetted water gas, a saving of 5d. (10 cents) per ton of gas coal compensates a penny (2 cents) per 1,000 cubic feet in the cost of the carburetted water gas.

Likewise, a market would have to be found for 1,400,000 tons additional gas coke per annum, if it were not for the manufacture of carburetted water gas. In this respect, coal gas works are now in a somewhat anomalous position, for they purvey both gas and coke for the same domestic purposes. The coke is sold at cost price, as far as comparison

with the cost of coal gas is concerned (since the whole revenue from coke is credited to that gas); but it competes with the very gas from which all profit is derived. Therefore, this 1,400,000 tons of coke, if thrown annually on the market, would tend to demoralize the present condition of the industry. It may be added that, with 33 per cent. of carburetted water gas, an increase of 10d. (20 cents) per ton in the price of coke compensates a penny (2 cents) per 1,000 cubic feet in the cost of the carburetted water gas.

7. Approximate independence of labor. For a comparison between carburetted water gas generating labor and coal gas carbonizing labor (including boilers and exhausters in both cases), upon the same basis and on a large scale of operation, the auther would take the following general ratio:

Carburetted Water Gas.	Coal Gas		
	Inclined Retorts.	Machine Work.	Hand Work.
1	3.5	4	6 to 7

The general labor is also greatly reduced.

8. Instant control of illuminating and calorific power—in case of variation in coal or other emergency—by simply changing the oil supply.

9. Prevention of naphthaline deposits. When mixed with coal gas, carburetted water gas acts as a solvent vehicle for naphthaline. With a properly made carburetted water gas naphthaline is unknown, and if a sufficient percentage of carburetted water gas of good quality be mixed with coal gas, it will largely or entirely prevent the precipitation of naphthaline from the coal gas.

10. Permanence. If one thing has been thoroughly demonstrated regarding modern carburetted water gas, it is essentially its permanence in distribution. The author's ample experience has convinced him that carburetted water gas, of 50 per cent. higher luminosity, is more permanent than unenriched coal gas. This he ascribes to the process of production, whereby certain condensable vapors—mainly benzene and naphthaline—are replaced by permanent gases.

11. Improved combustion. Unlike other enrichers, carburetted water gas may be freely burned in ordinary flat flame burners with less soot and noxious products than is the case with ordinary coal gas. This, as just stated, is due to the procees of production whereby certain coal gas vapors are replaced by permanent gases, and to the action of its carbonic oxide in promoting combustion. It is beginning to be recognized that similar benefit is realized in incandescent gas lighting.

12. Small proportion of sulphur. Crude carburetted water gas contains from one-fifth to one-tenth the sulphur usually present in crude coal gas; and, as this is almost exclusively in the form of sulphuretted hydrogen, simple oxide purification eliminates it almost completely.

The last two features govern a question of importance. The most rational basis for a sanitary comparison of ordinary town gases is probably with reference to their products of combustion, especially in view of the increasing use of flueless gas stoves. The entire population of every town is concerned with the purity of the products of combustion of the gas supplied, whereas those affected by the accidental escape of unconsumed gas represent an insignificant percentage, compared with the accidents attaching to other industries of similar extent. This view is reflected in the Parliamentary restrictions upon the quantity of sulphur permissible in London gas; although the limits have been fixed by the manufacturing possibilities of coal gas, not by the degree of purity desirable. As it is undoubtedly a fact that one of the principal causes, if not the chief cause, of the wide substitution of electric lighting for gas lighting is the character of the products of combustion of the gas, the importance of improvement in this direction cannot be easily magnified.

Value of Collateral Advantages.—From the above statement of collateral advantages, it is evident that a comparison of the ordinary bookkeeper's accounts, when coal gas and carburetted water gas are made concurrently, does not disclose the financial benefit resulting from the auxiliary manufacture of carburetted water gas, inasmuch as this auxiliary effect is to reduce the cost of the *coal gas* in many ways. Not only do the collateral economies go to the credit of *coal gas* in the accounts, instead of being credited to the carburetted water gas to which they are due; but the expenses by which they are accomplished (including the coke used by the process, at the enhanced price due to the use of the process) are charged against the carburetted water gas, thus doubly affecting the comparison of costs, *as shown by the accounts.*

In a paper read before this Association in 1899, the author endeavored to establish a truer comparison, by reducing certain of these economies to their financial equivalents. Considering, however, merely *the interest on first cost of works* (which is as necessary a part of the selling price of the gas as is the coal or oil used in its manufacture), the difference in capital charges in favor of carburetted water gas was found to be over 4½ cents (2¼d.) per 1,000 cubic feet, when each gas is made and distributed *per se.* But when carburetted water gas was treated as an auxiliary to coal gas manufacture (to the extent of one-third the maximum weekly production), this difference in interest became over 9 cents (4½ d.) per 1,000 cubic feet *of carburetted water gas produced.* [See *Proceedings American Gas Light Association*, Vol. XVI.; appendix, page lv.]

Present Status.—The following figures give approximately the proportion of carburetted water gas now manufactured:

The present annual output of town gas manufactured by the English-speaking race is:

	Cubic Feet Per Annum.
United Kingdom	160,000,000,000
Australasia	5,000,000,000
British Possessions	800,000,000
Canada	2,500,000,000
United States	90,000,000,000
	258,300,000,000

Of this total volume of manufactured gas, one-third (86,000,000,000) is carburetted water gas. Of this 86,000,000,000 cubic feet of carburetted water gas, about 20,000,000,000 cubic feet, or 23 per cent., is now being manufactured in the United Kingdom.

It is now advisable to consider briefly the general

Question of Quality.—The gas industry has no longer a monopoly, although it retains monopolistic superstitions. It must struggle for existence under the general laws governing industry and commerce, the fundamental requirement of which is to give the greatest value for the least money. In Great Britain, what Parliament may be induced to grant is becoming less important than what the consumer may be induced to use. Parliament may authorize business, but whether it will be worth continuing depends upon the consumer.

The broad question, therefore, is not whether 14 or any other candle power of gas is "good enough," but by what quality of gas, *as a vehicle*, can the maximum pecuniary equivalent in light, heat and power be delivered to the consumer? The catchcry, "Cheap gas!" is very like the free silver slogan, "Cheap money!" Gas, *as gas*, has no value to the consumer. Its whole value depends upon its ability to convey and develop useful energy, and that gas is cheapest which provides the maximum energy at the minimum price. That mission being fulfilled, the price per 1,000 cubic feet of the gaseous vehicle is a matter of indifference.

A reduction in the cost of gas, when its quality (calorific and illuminating) is maintained is an unqualified saving; but any method of "cheapening" gas by reducing its quality needs to be carefully weighed in order to discover if the real result be gain or loss.

Cost of Enrichment.—This question has two aspects, according to whether it is desired to find, (1) the cost of enriching an existing supply of ordinary coal gas; or (2), the cost of increasing the quality of an existing mixture of coal gas and carburetted water gas.

In the first case, the comparison, as with other methods of enrichment, is between the cost of the coal gas before enrichment and the cost of the enriched mixture. It involves an exact knowledge of: (A), the cost of the coal gas; (b), the proportion of carburetted water gas to be used; and (c), the cost of carburetted water gas of proper enriching quality. But (b) and (c) are interdependent; that is to say, the greater the proportion of carburetted water gas the lower its requisite candle power and the less its cost. For instance, to enrich 14-candle power coal gas to 16 candles requires 10 per cent. of carburetted water gas of 34-candle power, or 50 per cent. of carburetted water gas of 18-candle power. The difference in the London cost of 34 and 18-candle carburetted water gas is about 5d. (10 cents) per 1,000 cubic feet—say, for instance, 18 pence, (36 cents) and 13 pence (26 cents), respectively. The London cost of 14-candle power coal gas averages, say, 14 pence (28 cents) per 1,000 cubic feet. Then the enriched 16-candle power mixed gas costs, with the 34-candle enricher, 14.4 pence (28.8 cents) and, with the 18-candle enricher, 13.5 pence (27 cents), per 1,000 cubic feet. The "cost" of enrichment is, in this case, a saving or a charge, according as the greater or less proportion of carburetted water gas is used. This reasoning often explains discrepancies in the reputed saving or expense of enrichment by carburetted water gas. When, however, the cost of the carburetted water gas of the required town standard (16 candles) exceeds the cost of the unenriched coal gas, the enrichment is necessarily an expense. [For further explanation see *Journal of Gas Lighting*, Vol. LXIV., page 864.] But in the specific case of the Gas Light and Coke Company the expense of enrichment is a simple ques-

tion. This Company is already supplying a mixture of coal gas and carburetted water gas in given proportions. Its district standard is now 16 candles, and it is proposed to reduce it to 14 candles. It is necessary only to know the manufacturing saving due to this proposed reduction of two candles.

Assuming the entire enrichment to be by carburetted water gas, with oil at the somewhat high average price of 3d. per gallon, *the manufacturing saving will be one-third of a penny per candle; or two-thirds of a penny total manufacturing saving.*

Value of Enrichment.—It is now necessary to ascertain, and compare with the above saving in cost, the loss in useful effect of the same volume of gas due to this reduction in quality from 16 to 14-candle power. The loss in useful effect will be different, according to the use that is made of the gas, viz.:

(A) Where the calorific power, pure and simple, is utilized, as in stoves and engines.

(B) Where the incandescent effect is utilized, as by the Welsbach mantle.

(C) Where the flame luminosity is utilized, as in ordinary burners. The nominal loss in luminosity between 14 and 16-candle standards, tested in official Argands, is, of course, 12½ per cent.; but the actual loss in common flat flame burners is far greater.

Elaborate determinations have been made by numerous skilled, observers of the 16-candle power gas as actually supplied by the Gas Light and Coke Company, compared with the same mixture reduced to a 14-candle power standard, tested by the method prescribed for the 14-candle power gas of the South Metropolitan and the Commercial Gas Companies. The following results, verified by the author, are taken as representative.

I.—*With "C" Welsbach Burner.*—The 16-candle power district gas and the special 14-candle power gas consisted of two-thirds coal gas and one-third carburetted water gas in each case. The same ordinary (or "C") incandescent Welsbach burner (and mantle), as generally supplied in London, were used throughout. Each gas was burned at the rate best suited to the burner, without modification of gas nozzle. The air was especially regulated to give the best effect with the 14-candle power gas; but the burner was used unregulated, as supplied to the trade, with the 16-candle power district gas.

14-*Candle Power Gas.*

	Candles.
1. Illuminating power (in "London" Argand, at 16-candles luminosity, chimney 6 inches by 1⅛ inches; reduced to 5 cubic feet rate)	14.4
2. Incandescent effect (maximum light per cubic foot—rate 3.9 cubic feet per hour, air supply diminished).	20.3
3. Calorific power (Junker calorimeter):	
Gross value	582 B.T.U
Net "	529 "

16-*Candle Power Gas.*

	Candles.
4. Illuminating power (in "London" Argand, at 16 candles luminosity, chimney 6 inches by 1⅛ inches; at 5 cubic feet rate)	16.34
5. Incandescent effect, maximum light per cubic foot—rate 3.45 cubic feet per hour, air unregulated)	22.7
6. Calorific power (Junker calorimeter):	
Gross value	628 B.T.U.
Net "	567 "

Summary.

	Candles.
Difference in illuminating power	1.94
Loss in calorific power, 38 B.T.U.	6.70 per cent.
Loss in incandescent effect, 2.4 candles per foot	10.57 " "

II.—*With "Edinburgh" Welsbach Burner.*—The 16-candle power district gas and the 14-candle power gas consisted as before of two-thirds coal gas, and one-third carburetted water gas in each case. The same ordinary "Edinburgh" Welsbach burner (and mantle) were used throughout.

Each gas was burned at the rate best suited to the burner, without modification of gas nozzle. The air was regulated to give the best effect with each gas.

14-*Candle Power Gas.*

	Candles.
1. Illuminating power (in "London" Argand, at 16 candles luminosity, chimney 6 inches by 1⅛ inches, corrected to 5 feet rate)	14.8
2. Incandescent effect (maximum light per cubic foot—rate 3.35 cubic feet per hour, air supply diminished	21.4
3. Calorific power (Junker calorimeter):	
Gross value	582.4 B.T.U.
Net "	526.8 "

16-*Candle Power Gas.*

	Candles.
4. Illuminating power (in "London" Argand, at 16 candles luminosity, chimney 6 inches by 1⅛ inches, at 5 cubic feet rate)	16.7
5. Incandescent effect (maximum light per cubic foot—rate 3.35 cubic feet per hour, air supply diminished)	24.9
6. Calorific power (Junker calorimeter):	
Gross value	623.5 B.T.U.
Net "	564.5 "

Summary.

	Candles.
Difference in illuminating power	1.9
Loss in calorific power, 37.7 B.T.U.	6.68 per cent.
Loss in incandescent effect, 3.5 candles per foot	14 " "

III.—*With Flat Flame Burners.*—14-*Candle Power Gas.*—(14 8-candle power.)

	Candles.
1. 14-candle power (Parliamentary) Sugg governor burner; illuminating power for 5 cubic feet	11.4

16-*Candle Power Gas.* (16.66 C. P.)

	Candles.
2. 16-candle power, new Sugg governor burner; illuminating power for 5 cubic feet	15.77

Summary.

	Candles.
Difference in official illuminating power	1.86
Loss in flat flame burners, at 5 cubic feet rate per hour, 4.37 candles	27.7 per cent.

The above values are believed to represent practical use, but there are two features which must qualify the general application of all figures connecting incandescent effect with illuminating power.

1. Illuminating power is not a true criterion of calorific power or flame temperature; and, consequently, not of incandescent effect. Therefore, comparisons of this nature are accurate only when the base composition of the gas (*i.e.*, the diluents, H, CO and CH_4) remains relatively the same, and the difference in candle power is due to a regular increase in the natural proportion of heavy hydrocabons, in other words, when the comparison is between the two different qualities of the same gas, as it were, which after all is the real point in question.

2. Neither illuminating power nor incandescent effect are absolute quantities. They both depend upon the burner used and the method of testing.

This latter point is now well recognized in standard tests of flame luminosity. The difference between the Argand burners prescribed for official testing in London, and in Brentford, Wandsworth, Salford, etc., represents an increase of about 2 candles in the official quality of London 16-candle gas; while, with the prescribed London Argand, a carburetted water gas of 20-candle power, when burning at the rate of 5 cubic feet per hour, will lose nearly 2 candles when tested at 16 candles luminosity. There is greater difference with flat flame burners.

But in incandescent gas lighting the proper adjustment of burner and gas is everything. The first principle underlying the application of gas to incandescent lighting is to use it under proper conditions of combustion. Otherwise, comparison is not only futile but grossly misleading. For instance, the ordinary "C" Welsbach burner (owing to its low candle power origin) is less efficient with London 16-candle power coal gas than with London coal gas of 14-candle power. The remarkable failure to see that this is due to defects in the burner, *not* in the gas, has been chiefly responsible for the recent mistaken movement in favor of low grade gas, and for the hitherto successful attempts to influence Parlimentary legislation by means of such mischievous evidence as the "Dessau Diagram," of Messrs. von Oechelhaeuser and Schaeffer, "corroborated" by the South Metropolitan Gas Company (*Journal of Gas Lighting*, Vol. LXXV., page 1201), and the results communicated by Dr. Bunte to the Paris Gas Congress (*Journal of Gas Lighting*, Vol. LXXVI., pages 642-43), etc. In these comparisons, gases of widely different luminosity in flat flame burners were used in

the same Welsbach burner under the same conditions of combustion, and were valued accordingly! Those conditions, being suited to one quality only, gave the best efficiency only with that quality, and progressively poorer results according to the degree of variation from that quality. Moreover, the stated candle powers with flat flame burners, bore no practical relation to the composition of the gases, inasmuch as a normal coal gas was "benzolized," "stripped," or "doctored" in order to produce the other qualities.

It is common knowledge that gases of different composition and quality require different volumes of air for proper combustion, as well as different provision for proper mixture, before and during combustion, of these different proportions of air and gas. Moreover, the rate at which any gas is burned, in incandescent lighting, should be adjusted to the mantle so that the flame during combustion will exactly engage the mantle.[1] By observing these requirements, the Scott-Snell lamp was found by Mr. W. Cullen Morris to give an incandescent effect of 42 candles per cubic foot of 25-candle gas (*Proceedings American Gas Light Association*, Vol. XIX., page 307); and Prof. Lewes has obtained 146 candles by incandescent per cubic foot of acetylene (*Journal of Gas Lighting*, Vol. LXXX, page 1687). On the other hand, by violating these fundamental essentials of Bunsen combustion, Messrs. v. Oechelhaeuser and Schaeffer have concluded that "A decrease of 86 per cent. (from 13 to less than 2 candles) in illuminating power with the old burner was attended by an increase of 11 per cent. with the incandescent burner." Likewise, Dr. Bunte found "That great changes in the composition of the gas, which reduce the illuminating power in flat flame and Argand burners by more than one-half, or considerably increase it, and likewise greatly alter the calorific value of the gas, produce only relatively small differences in the illuminating duty with the Welsbach burner;" and upon "Such a remarkable fact," he based a theory of Bunsen combustion!

"And still the wonder grew," when leading British gas managers "corroborated" these irrational results, and influenced Parliamentary legislation by means of evidence diametrically opposed to the scientific facts of the case. This would seem an instance of the credulous hospitality often accorded statements that support predetermined conclusions. But the "C" Welsbach burner, while inefficient with London 16-candle coal gas, is nevertheless fairly suitable (unregulated) for the London 16-candle mixture of two-thirds coal gas and one-third carburetted water gas. That is to say, this same burner is about equally adapted to the present South Metropolitan, 14-candle coal gas and to the present Gas Light and Coke 16-candle mixed gas, and gives, with the latter gas, results about 10 per cent. higher than with the 14-candle coal gas. On the other hand, the "Edinburgh" burner, which in the matter of cost is a duplicate of the "C" burner, gives (unregulated) with 16-candle London coal gas results nearly 20 per cent. higher than the "C" burner gives with 14-candle London coal gas; whereas the calorific difference in these two coal gases is about 8 per cent.

The foregoing determinations of loss in useful effect, due to the reduction from 16 to 14-candle power, may be conveniently restated in the following comparative table:

	Loss between 16 and 14 candle power.	
Comparative Table.	By above determinations Per Cent.	Basis for Succeeding estimates Per Cent.
Calorific power	6.70	6½
Incandescent effect	12.28	10
Flat flame burners	27.70	25

Advantage of Enrichment.—At the present selling price of the Gas Light and Coke Company, viz., three shillings (75 cents) per 1,000 cubic feet, this reduction from 16 to 14-candle power means for:

	Loss in effect (Percentage)	Loss in value Per 1,000 cu. ft.	Saving in cost.	Net loss per 1,000 cu. ft.
Calorific power	6½	2.34d	.66d	1.68d
Incandescent effect	10	3.60d	.66d	2.94d
Flame luminosity	25	9.00d	.66d	8.34d

The net losses shown must be borne by the consumer or by the Company, or by both jointly. Assuming the output of gas to be utilized in the proportions given below the

Probable Average Loss between 16 *and* 14-*C. P. will be :*

	Volume Per cent.	Average Loss (Percentage)	Average Loss (Per 1,000 cu. ft.)
Calorific power	40	6½	2.34d
Incandescent effect	30	10	3.60d
Flame luminosity	30	25	9.00d
	100	13.1	4.71d

Average loss in useful effect.	Value of loss per 1,000 cu. ft.	Saving in cost.	Net loss per 1,000 cu. ft.
13.1 per cent.	4.71d.	.66d.	4.05d.

On the proposed basis of a compulsory compensation of 2d. in the price of gas for the 2 candles reduction in quality, this means a loss to the consumer of (4.71 — 2.00) = 2.71d. per 1,000 cubic feet, *and* a loss to the Company of (2.00 — .66) = 1.34d. per 1,000 cubic feet. Or, reckoned on the Company's present sale of 21,000 millions cubic feet, a loss to consumers of £237,000 ($1,150,000) per annum, and to the Company of £117,000 ($570,000) annually; being a total net loss of £354,000 ($1,720,000) per annum.

In the light of these figures, the Company could not intelligently adopt a 14-candle power standard, even were it authorized without compensation to consumers. An expenditure of two-thirds of a penny for a present saving of probably 4.7d. to consumers, could not be considered other than a prudent and economical insurance of the stability of the business.

It is possible that the gradual evolution of more perfect burners may reduce the above discrepancy between the difference in calorific power (6½ per cent.), and the difference in incandescent effect (10 per cent.); but, inasmuch as the richer gas has also a somewhat higher calculated flame temperature—apart from its greater calorific power—it is not probable that this discrepancy will be altogether eliminated.

If, however, this possible future change be discounted, by grouping incandescent effect with calorific power, and, moreover, the consumption alloted to flat-flame burners be halved, *the minimum prospective loss*, due to a reduction from 16 to 14-candle power, becomes:

	Volume, Per cent.	Average Loss (Percentage)	Average Loss (Per 1,000 cu. ft.)
Calorific power / Incandescent effect	85	6½	2.34d.
Flame luminosity	15	25	9.00d.
	100	9.27	3.33d.

Average loss in useful effect.	Value of loss per 1,000 cu. ft.	Saving in cost.	Net loss per 1,000 cu ft.
9.27 per cent.	3.33d.	.66d.	2.67d.

Hence, this minimum future loss would be: To the consumer 1.33d. per 1,000 cubic feet, or £116,000 per annum; and to the Company still 1.34d. per 1,000 cubic feet, or £117,000 per annum; being a total annual prospective loss of £233,000, reckoned on the present output.

But under the practical operation of the Parliamentary sliding scale (which establishes a community of interest between consumers and shareholders) the distribution of profits is in such relation to the price legally charged that the consumers bear nearly the whole of the above losses; *i. e.*, the loss directly ascribed to them, and about four-fifths of the loss ascribed to the Company. We have, therefore, the curious spectacle of the consumers' guardian (in the guise of the London County Council) promoting legislation, in the supposed interest of the consumers, the immediate effect of which would be a loss *to the consumers* of about 3.75d. per 1,000 cubic feet of gas consumed. It has remained for the most maligned of English gas companies to successfully resist this wasteful movement, in opposition, not only to recent Parliamentary precedents effected by acknowledged leaders of the industry, but to the local authority (representing the consumers), and to an influential section of the technical press.

If the foregoing values are correct the case for 14 *versus* 16-candle gas in London falls hopelessly to the ground. It only remains, therefore, to ascertain whether the evidence advanced in favor of low grade gas qualifies in any way the above conclusions. To this end (and somewhat by way of a summary of the preceding pages) it will suffice to traverse briefly the public arguments of Sir George Livesey, Chairman of the South Metropolitan and Crystal Palace Gas Companies, Director of the Commercial Gas Company, and undisputed leader in Great Britain of the current low grade movement.

In his paper "The Enrichment of Coal Gas" Sir George Livesey states that there are "Only three systems in general use;" with reference to cannel enrichment "Its cost puts it out of court;" "enrichment by spirit vapor is useless, and simply a waste of the consumers' money;" "And carburetted water gas is objectionable from its nature and the difficulty and uncertainty of mixing."

Sir George Livesey has had wide experience with cannel and vapor enrichment, and the author fully concurs in the conclusions drawn therefrom; but facts permit carburetted water gas to be dismissed in this fashion—only by one who could also avow, "I know nothing of water gas, and I am rather glad I do not." (*Proceedings Inst. C. E.*, Vol. CXLVI., page 83)—notwithstanding that carburetted water gas

1. The author directs attention to the valuable papers from time to time communicated to the Michigan Gas Association by Professor A. H. White and his associates.

already forms one-third of all town gas manufactured by the English-speaking race.

To better gauge the bias that characterizes any improvement of common coal gas as "adulteration," let us imagine for a moment the original introduction of coal gas and carburetted water gas in reverse chronological order. Suppose that the British gas manager had devoted his life to carburetted water gas, and that a foreign development called coal gas were being urged upon him. The argument in its favor would analyze somewhat as follows:

It is true that the proposed coal gas requires twice the capital expenditure, three times the ground area, from three to six times the manufacturing labor, and large additional operations in residuals, since only 20 per cent. of the coal purchased can be converted into gas; moreover, the new gas is limited to (say) 14-candle power, and the individual services are subject to stoppages from naphthaline; the presence of benzene and naphthaline make it less permanent than the existing supply, and it contains many times as much sulphur; its combustion is less perfect, owing largely to the presence of less carbonic oxide, and it yields more offensive products; and, for the same quality, its average holder cost is generally more—often much more. But, against such disadvantages, *there is the satisfaction of supplying "unadulterated" coal gas, made from* [now increasingly scarce] *British coals!*

In these circumstances, who would even consider the *complete substitution* of coal gas for carburetted water gas? Yet, an equivalent result prevails to-day in many of the British gas works that do not practice the auxiliary manufacture of carburetted water gas. As already pointed out this auxiliary manufacture of carburetted water gas not only affords a perfect means of enrichment, *but also largely eliminates the disadvantages of coal gas per se;* moreover, it realizes important opportunities that attach to the system of *dual manufacture*, and that are lost when either gas is made exclusively. One such feature is illustrated in Sir George Livesey's Parliamentary testimony; May 3, 1900: "The crucial point is whether the consumers shall have gas at all—not whether it shall be a candle more or less. The largest gas works in London were recently within 6 hours of exhausting their supply of coal. We have been hovering for weeks on two days' supply, and what we are to do this year I do not know." The then coal crisis was due, not to strikes or *force majeure*, but to commercial and trade conditions resulting from general industrial prosperity—which it is to be hoped may be oft recurring.

In the face, therefore, of merely sentimental and imaginary objections, it may be reasonably held that the ease and cheapness of enrichment by carburetted water gas, as specifically stated herein, remain established.

Next, as to the value of enrichment. Quoting from Sir George Livesey's paper:

"No one can seriously argue that the slightly higher calorific value of enriched gas, even if the enrichment reaches the consumers, is desirable for heating, cooking, power and trade or manufacturing purposes. A lower price rather than the higher quality is what consumers want; and as to incandescent lighting, experiments made in Germany (and corroborated in England), have proved that with the Welsbach burner the light actually increases as the illuminating power of the gas diminishes. To illustrate this point, diagrams showing the result of the German and English experiments have been prepared; for to a fact of such great importance special prominence must be given."

From this text, inspired by the "Dessau diagram" and similar experimental follies, was developed the Parliamentary evidence that secured the Acts of 1900 and 1902, reducing the illuminating standard of the South Metropolitan and Commercial Gas Companies from 16 to 14-candle power.

The foregoing pages have demonstrated—what must be self-evident to any impartial mind—that the *quality* of gas is neither immaterial, nor yet a positive disadvantage; but, on the contrary, that the above statement is based upon violation of the first principles of combustion, and is diametrically opposed to fact. Again, with reference to flat flame burners:

"Consumers have it in their power, even with ordinary burners, to increase or diminish the light obtained from the gas to a far greater extent than the difference produced by enrichment.

"In illustration of this point, the burners (flat flame) of 50 consumers taken indiscriminately, who lately complained of a bad light, were tested. The illuminating power yielded by these burners ranges from 6 to 17 candles. The gas used was of 16-candle power, burnt on the best conditions as to pressure and quantity for obtaining the most light—more than the consumers would obtain, because they would not burn under those conditions. Of the 50 burners, the highest result per foot of gas, calculated to 5 feet per hour, was 16.9 candles, and the lowest was 6 candles. There were 3 over 16 candles, 2 under 7 candles, and 15 (or 30 per cent.) under 10 candles. These complaints, as is the case with all others, were remedied, not by increasing the illuminating power of the gas, but either by changing the burners or improving the supply of gas."

Here we have Sir George Livesey's evidence that 16-candle gas under proper governing, will give 16 candles in a suitable flat flame burner; against his later Parliamentary evidence (June 30, 1903): "The consumers had used bad burners which gave on the average 9 candles."

Instead, however, of encouraging his consumers to use burners which would increase their average light (for the same consumption) from 9 candles to 16 candles, he advocates a poorer quality because, even with 16-candle gas, consumers with "bad burners" get a poor light. To sustain his case, he undertakes to supply all his consumers without charge with governor burners especially constructed to give the maximum light with 14-candle gas. It transpires, however, that this new burner gives about 11½ candles with 5 cubic feet of 14-candle gas, whereas the similar burner for 16-candle gas gives about 16 candles.

It is evident that the illogical attempt to disparage 16-candle gas, on the ground that this perfect "new burner" gives a better light with gas of 14 candle power, than "bad burners" give with nominal 16-candle gas, in no way qualifies the author's previous conclusions.

We may now pass to the final phase of the current case for low grade gas—namely, the evidence of the South Metropolitan Gas Company that, since their adoption of the 14-candle power standard, no more gas has been consumed than would be accounted for by normal increases. This is cited by advocates of low grade gas as conclusive proof that 14-candle gas is as good for the consumer as gas of 16-candle power. The South Metropolitan circumstances do not warrant such a conclusion.

First, and foremost; the South Metropolitan Company employed vapor enrichment, when under the 16-candle power standard, and admittedly did not supply 16-candle gas to their consumers. We have the specific statement of the Chairman of the Company, corroborated by the Parliamentary evidence of the Chief Chemist and Superintending Gas Examiner of the London County Council, that the gas delivered to the consumer, with and without enrichment, was of practically the same candle power. Their Chairman stated in Parliamentary evidence (May 3, 1900) he had never understood that they were to supply 16-candle gas to every consumer, but that it was to be 16-candle power as sent out from the works, and that gas of 16-candle power was to be found at the testing stations. "My opinion is that if Parliament had intended 16-candle gas to be given everywhere, it would have required us to supply 17 candles."

No one denies that the Company have lived up to this limited sense of their obligations, and that their works and official tests have satisfied the legal standard; but inasmuch as their method of vapor enrichment was worthless, the fact remains that practically the same gas reached the consumer before and after the abolition of their so-called enrichment. Hence, there is no reason why an abnormal increase in consumption should have followed the abolition of such enrichment.

Secondly, coincident with the Companys' adoption of the 14-candle power standard, their consumers were supplied *gratis* with special governor burners giving about 11½ candles with 14-candle power gas in the place of "Bad burners which gave on the average 9 candles" Also, the energetic policy of the Company in extending incandescent gas lighting effected substantial saving in the consumption of gas. To quote the Chairman at the last half-yearly meeting of the South Metropolitan Company:

"What the Company have done has been to supply, under their act, new and improved burners—the best burner that could be obtained or could be made for burning ordinary gas on the flat flame system. We have supplied these by hundreds of thousands to our customers in exchange for burners that did not (many of them) give much more than half the light that is now obtained from these improved burners with a lower quality of gas. Then there is another great improvement in the consumption of gas by means of the Welsbach incandescent mantle. We have now a very large staff of men—between 60 and 70—engaged at the present moment in doing nothing but visiting the consumers and attending to their incandescent mantles. Well, the result of the recent introduction of the improved flat flame burners, whereby the illumination is nearly doubled compared with that obtained from the old and unsuitable burners, and of the incandescent mantle, whereby the light is increased about sixfold, is that the consumers burn less gas."

It is needless to mention other argumentative questions involved in a general comparison of this character. Enough has been said to show that the compartive outputs of the South Metropolitan Company, during and after their attempted enrichment, have no bearing upon the comparative values of 16 and 14-candle gas.

On the other hand, it is seen above that low grade zealots "blow hot and cold with the same breath." They obtain relief from a useless method of enrichment, because it does not reach the consumer, and they accompany its abolition with the most comprehensive and enlightened means of saving gas; then, because an abnormal increase in gas consumption does not follow the abolition of this normal enrichment, they declare that 14-candle gas is conclusively proven to be as good as gas of 16-candle power, and that all "theory" must consequently be flung to the winds.

In the Crystal Palace Company's recent attempt to reduce their illuminating standard from 15 to 13-candle power, their Chairman testified (June 30, 1903):

"*The Company proposed to give the consumers the whole of the saving. They found that the enrichment cost them ½d. a candle; and that being so, if they reduced the selling price a penny, they would give the consumer all the saving.*"

Here is a bill, promoted ostensibly in the sole interest of the consumers, that proposed to compensate them 1d. per 1,000 cubic feet (or 3½ per cent.) for a reduction in standard quality of 2 candles (being 13⅓ per cent. by photometric standards, and *over 25 per cent. in flat flame burners*), notwithstanding the Company's testimony "That 36.6 per cent. of the gas supplied by the Company was used for heating, cooking, engines and incandescent lighting; the remainder [63.4 per cent.] being used in flat flame burners!"

The author thinks he may now end his cross-examination, without qualification in the conclusions he has previously established herein.

With such a case for enrichment, it is scarcely necessary to refer to the foolish attempts *to dilute coal gas* by the admixture of blue (or lightly-carburetted) water gas, although the author has been to some trouble to ascertain what the present advocates of this plan have to say in its favor. Their policy appears to have no other foundation than the superstition that "Consumers care nothing for quality; what they want is 'cheap' gas," sometimes supplemented by the erroneous assumption that greater economy attaches to the manufacture of blue water gas in the Dellwik generator than in the Lowe process. This idea of "cheap gas" has been already referred to under "*Question of Quality;*" and for a detailed exposition of this issue the author would refer to his letters on "Flame Luminosity and 'Cheap' Gas;" and on "Blue Water Gas," in the "*Journal of Gas Lighting*," March, April and May, 1902; and February, March, April and May, 1903.

Finally, *with reference to American conditions:*

With similar gases, the advantage of enrichment is greater in America than in London, because

(A). The average cost of enrichment is somewhat less in America—say, one cent for the two candles, against .66d. in London; and,

(B). The average selling price of gas, in common with most commodities, is considerably higher in America—being $1.035 per 1,000 cubic feet, by the census of 1900, against 75 cents in London. Hence, in America, the London situation would average as follows:

Result of Reduction from 16 to 14 Candle Power.

Average Loss in Useful Eff ct.	Value of Loss per 1,000 cu. ft.	Saving in Cost.	Net Loss per 1,000 cu. ft.
13.1 per cent.	13.5 cents.	1 cent.	12.5 cents.

Foreign Technical and Trade Schools.

By A. F. TENNILLE, in *Electricity*.

The matter of technical and trade schools is one that is fixing itself upon the attention of thinking business men in all parts of our own and other countries, as is evidenced by the prominence that is being given to the technical side of our public school system, and the many schools which are devoted entirely to technical pursuits. This is equally the case in foreign countries; indeed, in Germany alone we find that there are 44 schools for training workmen in the various industrial arts, and 287 industrial schools in Saxony, and most, if not all, of the establishments are the growth of the 19th century.

In Saxony one of the four courses is electrical, and the conditions of admission demand that the student shall have sufficient education to be in possession of a certificate which entitles him to 1 year's service in the army, and must also show evidence that he has passed 2 two years in some establishment by which he may have acquired a practical knowledge of that branch of the industry.

There are 9 technical high schools in Germany—with an attendance of 15,000 students, no less than one-sixth of whom are foreigners, and among these are to be found many Americans.

In Berlin we find an Artisan's School No. 1, a trade school for instrument makers, and a day class in electro-technics where journeymen electricians are given such theoretical instruction as enables them to become mounters of electrical apparatus, foremen, laboratory workers, etc.

In Hamburg, at the Technikum, there is a superior school of electro-technics where there is always a good attendance, and where, in addition to a full theoretical course in electricity, excursions are made to various electrical plants where practical demonstrations can be made and seen.

In a school at Wurtemberg special attention is given to electrical clock and instrument manufacture, such as measuring instruments for electro-technical purposes, electric lamps, etc.

This work is not confined to Germany but is spreading all over industrial Europe, and Italy by her work in this direction is doing much to counteract the widespread emigration of her poorer classes, and, at the same time, has increased her productive capacity very materially. Mechanics and mechanical industries are among the subjects taught.

During last year a very important step in this direction was taken by a wealthy organization of Milan, looking to the establishment of a new school of electro-technics, which has received material mechanical aid from the king, and where electro-technics, practice in electrical measurements, the designing of electrical machinery and the construction of electrical apparatus will be studied, to which will be added practical work in central electrical stations and other electrical plants, also in telegraph and telephone plants.

In Holland very highly equipped workshops have been built as adjuncts to the industrial schools, and the workshops are many of them equipped with electrically propelled machinery wherever it has been found possible to employ same.

Russia is taking the matter up with a degree of earnestness commensurate with her need in this direction, and not only is this true, but Russian students form a large percentage of the foreigners who are matriculated in the German technical universities. The schools in Russia are nearly all connected with large factories, and students receive wages for work actually performed, and they assist in the manufacture of motors and other electrical equipment.

Turning our attention to the development that has been made in France along this line we find that the industrial school at St. Etienne is finely equipped for work; the course of this institution covers four years. Industrial electricity is taken up during the third year, and the general principles are well taught, including the different forms of energy, the conservation of energy, the transformation of heat and of power into electricity, and *vice versa*, the transmission of power, the definition of work, of power, and of units is taken up; the mechanical equivalent of heat; electric currents and circuits; electromotive force, resistance, intensity, conductibility, potential, etc.; the volt, concomb, ampere, ohm, joule and the watt. Exercises and problems are given; the study and use of batteries, magnets, solenoids, electromagnets, and mechanical electro generators; the industrial application of current as in electric bells, the telegraph, the telephone, electric light, electroplating, etc., are all thoroughly covered. This is followed up in the next year's work when practical applications are made of all the previous work along extended lines; and in the workshops pupils construct electrical apparatus, measuring instruments, dynamos, and electrical motors under the personal supervision of and from plans prepared under the direction of the professor or the foreman of the workshop. This course has only been opened since 1892.

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This subject might be followed up almost indefinitely, and into the technical institution of the United States, but with this we are more generally familiar. The main thought, however, in all this work is the fitting of the human intellect so that it may be in a position to grapple with the advancing requirements of our times and all times; and it is in these multiplying opportunities for technical and industrial education that we may find, perhaps slowly, but certainly surely, the solution of the problem of disquietude and unrest that pervades the masses. A mind fully occupied is a most excellent cure for the old adage respecting the finding of mischief for idle hands to do.

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When the question is that of the delivery of fluids in channels or pipes, however, this preliminary establishment of the absolute limit beneath which all phenomena must fall, it is not so generally seen to by teachers, nor sought after by students. We can see this shortcoming, for example, in the common failure to perceive the limitation of the effect of fall in a line of water pipe, or a watercourse, to increase the rate of flow. Yet it is a fact that lies on the surface of every cascade, rapid, or sloping weir. Quite a ripple of surprise was felt, and caused, by a correspondent of "Nature" a short time ago, when he announced the discovery that there could be no further gain of velocity by increasing the fall of a water pipe more than about 3 per cent. This merely meant that beyond a certain degree of inclination of a rapid, or the front of a cascade, no more water will go down; but it requires a distinct mental effort to think of a water pipe as an inclosed waterfall.

The same observation applies to movement of gaseous matter in pipes, which also fulfil the duty of keeping its nature unaltered. Again, it requires a mental effort to consider the movement of gases in pipes as that of a body simply under the force of gravitation. It helps one to regard the problem, in the first line, as that of a body falling freely in a perfect vacuum with the velocity due to the height of the fall. This is given by the expression ($\sqrt{H} \times 8$). In words, the velocity of the fall in feet per second is the product of the square root of the height of the fall in feet, into 8. Now, what is the height of the fall in the case of a gas escaping into a vacuum? It is the height of a vertical column of the gas which will give a pressure equal to that of the atmosphere—no more, no less. This is the maximum—why, we shall shortly see. There is a very simple example of the necessary calculation in Box's Treatise on Heat, p. 75 (Edition of 1868). Here we find that, the atmospheric pressure being taken at 30 inches of mercury. which has a density (relative to air) of 13.596 to 0.001221 at the same temperature, the height of the column of air to give the same pressure as the column of mercury is $\frac{13.596 \times 30}{.001221 \times 12} = 27{,}838$ feet. Wherefore the velocity of the fall is $\sqrt{27{,}838} \times 8 = 1{,}344$ feet per second.

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Subject, therefore, to the single element of the increase of density with the pressure, which alters the quantity passed through a discharging orifice from which it is afterwards allowed to expand to the normal density, the discharge of a fluid is a maximum under the condition of a flow from under atmospheric pressure into a vacuum. This gives the maximum velocity of flow, and every actual discharge must be at a slower rate. We have already seen that in the case of air, the calculated theoretical maximum velocity is about 1,344 feet per second, which is, of course, fictitious. It is nevertheless worth something as an approximation to the truth. With coal gas of 60 per cent. less density, the maximum velocity might approximately be 1,600 feet per second. Although nothing approaching this rapidity of movement is at present attained by exhausting or pumping machinery, the possible use of steam or gas turbines in this connection is not to be lost sight of. In practice, many facts prevent the attainment of anything like the maximum velocity by gas travelling in mains; but there is clearly a considerable margin available for the speeding up of the propelling machinery before the limit will be reached.

It is needless to mention other argumentative questions involved in a general comparison of this character. Enough has been said to show that the compartive outputs of the South Metropolitan Company, during and after their attempted enrichment, have no bearing upon the comparative values of 16 and 14-candle gas.

On the other hand, it is seen above that low grade zealots "blow hot and cold with the same breath." They obtain relief from a useless method of enrichment, because it does not reach the consumer, and they accompany its abolition with the most comprehensive and enlightened means of saving gas; then, because an abnormal increase in gas consumption does not follow the abolition of this normal enrichment, they declare that 14-candle gas is conclusively proven to be as good as gas of 16-candle power, and that all "theory" must consequently be flung to the winds.

In the Crystal Palace Company's recent attempt to reduce their illuminating standard from 15 to 13-candle power, their Chairman testified (June 30, 1903):

"*The Company proposed to give the consumers the whole of the saving. They found that the enrichment cost them ½d. a candle; and that being so, if they reduced the selling price a penny, they would give the consumer all the saving.*"

Here is a bill, promoted ostensibly in the sole interest of the consumers, that proposed to compensate them 1d. per 1,000 cubic feet (or 3½ per cent.) for a reduction in standard quality of 2 candles (being 13⅓ per cent. by photometric standards, and *over 25 per cent. in flat flame burners*), notwithstanding the Company's testimony "That 36.6 per cent. of the gas supplied by the Company was used for heating, cooking, engines and incandescent lighting; the remainder [63.4 per cent.] being used in flat flame burners!"

The author thinks he may now end his cross-examination, without qualification in the conclusions he has previously established herein.

With such a case for enrichment, it is scarcely necessary to refer to the foolish attempts *to dilute coal gas* by the admixture of blue (or lightly-carburetted) water gas, although the author has been to some trouble to ascertain what the present advocates of this plan have to say in its favor. Their policy appears to have no other foundation than the superstition that "Consumers care nothing for quality; what they want is 'cheap' gas," sometimes supplemented by the erroneous assumption that greater economy attaches to the manufacture of blue water gas in the Dellwik generator than in the Lowe process. This idea of "cheap gas" has been already referred to under "*Question of Quality*;" and for a detailed exposition of this issue the author would refer to his letters on "Flame Luminosity and 'Cheap' Gas;" and on "Blue Water Gas," in the "*Journal of Gas Lighting*," March, April and May, 1902; and February, March, April and May, 1903.

Finally, *with reference to American conditions:*

With similar gases, the advantage of enrichment is greater in America than in London, because

(A). The average cost of enrichment is somewhat less in America—say, one cent for the two candles, against .66d. in London; and,

(B). The average selling price of gas, in common with most commodities, is considerably higher in America—being $1.035 per 1,000 cubic feet, by the census of 1900, against 75 cents in London. Hence, in America, the London situation would average as follows:

Result of Reduction from 16 to 14 Candle Power.

Average Loss in Useful Eff. ct.	Value of Loss per 1,000 cu. ft.	Saving in Cost.	Net Loss per 1,000 cu. ft.
13.1 per cent.	13.5 cents.	1 cent.	12.5 cents.

Foreign Technical and Trade Schools.

By A. F. Tennille, in *Electricity*.

The matter of technical and trade schools is one that is fixing itself upon the attention of thinking business men in all parts of our own and other countries, as is evidenced by the prominence that is being given to the technical side of our public school system, and the many schools which are devoted entirely to technical pursuits. This is equally the case in foreign countries; indeed, in Germany alone we find that there are 44 schools for training workmen in the various industrial arts, and 287 industrial schools in Saxony, and most, if not all, of the establishments are the growth of the 19th century.

In Saxony one of the four courses is electrical, and the conditions of admission demand that the student shall have sufficient education to be in possession of a certificate which entitles him to 1 year's service in the army, and must also show evidence that he has passed 2 two years in some establishment by which he may have acquired a practical knowledge of that branch of the industry.

There are 9 technical high schools in Germany—with an attendance of 15,000 students, no less than one-sixth of whom are foreigners, and among these are to be found many Americans.

In Berlin we find an Artisan's School No. 1, a trade school for instrument makers, and a day class in electro-technics where journeymen electricians are given such theoretical instruction as enables them to become mounters of electrical apparatus, foremen, laboratory workers, etc.

In Hamburg, at the Technikum, there is a superior school of electro-technics where there is always a good attendance, and where, in addition to a full theoretical course in electricity, excursions are made to various electrical plants where practical demonstrations can be made and seen.

In a school at Wurtemberg special attention is given to electrical clock and instrument manufacture, such as measuring instruments for electro-technical purposes, electric lamps, etc.

This work is not confined to Germany but is spreading all over industrial Europe, and Italy by her work in this direction is doing much to counteract the widespread emigration of her poorer classes, and, at the same time, has increased her productive capacity very materially. Mechanics and mechanical industries are among the subjects taught.

During last year a very important step in this direction was taken by a wealthy organization of Milan, looking to the establishment of a new school of electro-technics, which has received material mechanical aid from the king, and where electro-technics, practice in electrical measurements, the designing of electrical machinery and the construction of electrical apparatus will be studied, to which will be added practical work in central electrical stations and other electrical plants, also in telegraph and telephone plants.

In Holland very highly equipped workshops have been built as adjuncts to the industrial schools, and the workshops are many of them equipped with electrically propelled machinery wherever it has been found possible to employ same.

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British Manufacturers Handicapped.[1]

England has been sharply criticized for her want of enterprise as we understand it in this country, but there are two aspects of every question, and some very good reasons for the course of English manufacturers are given by one of them, who is, apparently, familiar with his subject from every point of view, as it affects the obstacles in the way of adopting new methods. In an article entitled "The Inspection of Materials" in the *Engineer*, London, a manufacturer says, bearing on the foregoing:

The whole tenor of life of man has taken on a different aspect, and the world to-day has little in common with that of a hundred years ago. Work was then of the slow, plodding, but eminently thorough order, and a man invariably put his best into what he did for the sake of the work itself. To-day, with so much to do and so little time to do it in, a man has little or no pride in his work. His sole and only motive is the mercenary gain that walks in its wake. However much we, as manufacturers, may protest against the ridiculous demands of a specification, we must admit that it is owing to the shortcomings of our predecessors that there are any specifications. They can hardly be held responsible, however, for the present development of them, that being due to the impracticable notions of the academically instructed engineer in charge. * * * It is very curious and unsatisfactory that, notwithstanding the thousands of specifications which have been written, there is not even a general agreement among engineers as to what constitutes essentials, let alone minor points. It is not exaggeration to say that no two of them agree, although the jobs are of exactly the same character. Take any average specification and read it through. Note the minute instructions as to setting out, handling and all the progress through the shops, the pains and penalties for doing this and that, the allowances and deductions to be made, the rigorous conditions as to labor, the must and must nots that adorn every paragraph, and the wonder is that anything can be done. Add to this a person who reads things into specifications that are not written in them, and is constantly unearthing hidden meanings, to his own great satisfaction, and one may fairly comprehend some of the obstacles that British manufacturers have to contend with. We have all been chagrined lately, many times, to see desirable work go out of the country and have foreigners reap the benefit of it, but we must admit we are far above them in the matter of cost. Is it reasonable to expect things to be otherwise when conditions are so different? Foreigners will not accept our specifications, or endure our system of inspection at their own price, or any price, for that matter. Considering the conditions to be fulfilled, British manufacturers are far ahead of competitors, as they are the only firms that will even attempt to follow plans, and yet it should not be assumed that British work is the best for its purpose, whatever that may be. "Best" means a great deal. By it we understand the highest finish and the closest attention to detail, but few of us would care to say that better, in the sense of more useful, work could be done by English firms than is turned out by the American Bridge Company or the Baldwin Locomotive Company. Every essential for the work they have to do is found in these concerns and their products; they give the maximum of efficiency at the minimum of cost, and we cannot touch them in price because we cannot do as they have done. They work to specifications and undergo inspection as we do. With this exception their plans and the verification of them are made by themselves, while we have to stand the cross fire of outside engineers and inspectors. The Baldwin locomotive is a Baldwin the world over, and as for the American Bridge Company, their work is standard and never fails of recognition. So far as modern science goes, their goods are the best value for the money. How under our conditions are we to keep to our standard of workmanship and reduce costs so as to be able to compete with them?

It should be borne in mind by our readers that the practice of building engines or machinery of any kind for English works is very different from that of our own country. Firms of consulting engineers bid for and obtain contracts, which they sublet, or have constructed by machine works in any locality; these last are accountable to the parties of the second part, and have nothing to do with the actual owners of the engines or machine plants. There is a dual control, in one sense of the word, for the actual owners exercise supervision over the engineers in charge, and the latter hold the actual builders responsible. In this country projectors of any enterprise go directly to the machine builders and ignore consulting engineers wholly. There are exceptions to this rule in some cases, and the English method is followed, but by far the greatest part of the work is done by contracting directly with the builders in the first instance. The English method is open to objections, for as there are numerous designers, it follows that there are numerous specifications, and these last differ much more than one star differeth from another, and it is right on this very practice that so much trouble is encountered. The author above quoted says:

It is here where the difference lies between ours and a younger country. In the latter it is possible to start at once and build up a business with all the experience that can be commanded, and no prejudices or vested interests to contend with. Under such conditions it is natural that subsequent growth should be greater and healthier, but to attempt to reconstruct our commercial life and place it on those lines which experience and common sense would dictate as most conducive to economy and success would require such an outlay and involve the ruin of so many thousands now gaining their bread in our businesses that it might also prove the ruin of the whole country. For good or for ill, certain conditions are with us, and our work must be to make the best of them in every way.[1]

It is the uncertainty of the conditions that cripples us. The mere fact that A requires a joint to be riveted while B wants it welded is not material, but what is important is that A wants it riveted by hydraulic pressure, while B insists that it shall be done pneumatically. Another engineer wants nothing but hand riveting, and still another requires steam to be used. Even when they all happen to agree upon the agent to be employed to close the rivets, then there arises the momentous question as to the heating of the rivets. One wants the end white hot at the point only; another asks that they be white hot on the shank only, and still another demands white heat throughout. After these comes another man who needs red heat all over. Concerning the holes in the plates, they must be punched for one man, drilled for another, punched first and reamed after for another, and both plates must be superposed and holes drilled at once for another. The variations in test specimens and the limits of elasticity, bending tests, quenching tests, and the various angles to which they must be bent, are all in dispute. Nothing has been said as yet concerning analyses of plates, but this point is also dwelled upon in so great detail that manufacturers are harassed beyond endurance. If, however, any one of them thinks that he has at last reached the limit of requirements, he is held up on the character of the steel. Whether it shall be open hearth, basic or Bessemer, these are all discussed, with various details as to the age, religion and moral character of the men who made them, possibly, until patience is exhausted. It seems that the consulting engineer spent laborious days in trying to discover something that no one had thought of hitherto, in order to embody it in his specification. Is it any wonder that the British manufacturer, according to his critics, is "a man of no originality?" Is there anything left for him to exercise originality upon? Throw away all this pother about stipulations and substitute for it some standard universally recognized, and the British manufacturer will stand a fair chance of vindicating himself; such a standard, for instance, as Lloyd's in the shipbuilding trade and the Steam Users' Association in the boiler trade. * * * Locomotive building and bridge building in England are practically extinct to-day; they are a bad second in the world's markets. Competitors have stolen our laurels and foreign countries are in the proud positions which should have been ours. We established them with a firm hold, but we have lost them; outside our home market and our colonies no one wants our goods. It is not because they are shoddy—questions of quality have never been raised—but we have been, and are, accused of want of originality, lack of business ability, and every commercial virtue pretty nearly under the sun, except want of thoroughness. This, fortunately, we are permitted to retain. Few of our mentors, however, have hit upon the real cause of our decline in the directions mentioned. Manufacturers have suffered the gibes and jeers of the knowing and allowed them to pass unchallenged, but the truth has been set forth in previous lines, and this is that the lack of standards in certain branches of trade has made British manufacturers the butt of critics all over the world. Manufacturers of every shade of opinion in the two trades which languish are in accord in ascribing present conditions to the causes named—a lack of a central authority, such as Lloyd's, and the non-existence of them in the other trades. The locomotive and bridge building branches are handicapped, but this is not true of shipbuilding and marine engineering, in which directions we have no competers. It is true that neither ships nor engines are duplicates of each other. There are variations and differences, but the same quality and work-

1. *Iron Age*.

1. The same idea of the industrial situation in England has been expressed in the *Iron Age* in very nearly the same language, and it is, in a sense, interesting to find it corroborated by an English manufacturer.

manship is demanded in both. The grand difference is that they have a known and invariable specification to work by, while the others have virtually nothing; certainly no two specifications concur. The direct and concrete results are that English ships and marine engines are the best in the world, while, on the other hand, our locomotives and bridges are the dearest and most unsatisfactory.

In other lines—say hardware and small goods generally, screws, bolts and nuts—the same general principles advocated prevail. There must be and there are standards for the finished articles before success can be obtained. Machines will work only in one way—the one in which they are set—and will turn out the same degree of workmanship, barring wear and tear. Whatever the standard determined upon machines will produce, but there are always standards in any event. Suppose shipbuilding had been subjected to the same conditions as bridge building, every unimportant detail liable to a specification, would it ever have reached its present stage? It certainly would not.

It is, perhaps, unnecessary to follow the writer of the article further in his argument, which is a strong plea along certain lines. Its frankness and candor are remarkable, but without intending to criticize it adversely, it seems to us rather a special plea for some branches, and does not wholly explain the want of enterprise which characterizes British industries by and large. Commissions visit us, and are given the freedom of our shops without reservation. The members composing them are experts themselves, and can understand, or rather see, without comprehending, in some cases, how we turn out double and more than they do in a given time; then the commissions return and report that our boasted superiority is a sham, and that if, perchance, our tonnage output is greater occasionally, it is inferior in quality and workmanship to their own, and they adhere more firmly to the ways their fathers walked. We have no quarrel with this method of meeting competition, because it does not compete, but the writer of the article reviewed fails to recognize this weakness of his countrymen, ignoring it wholly. And yet it is a very prominent factor in the argument of commercial supremacy. This is not an occasional happening with commissions; year after year delegations visit us, and go through the same routine without profit to them of any kind, for they have followed their plans for hundreds of years, and will not, even if they were so constituted that they could abandon them. There are no bugaboo specifications in this line of business to affright them, simply a change of machines and methods, but these are unchanging in Great Britain.

It is fresh in the minds of all who read what is going on in the world of trade that an American contractor who had large buildings to erect in England offered them to resident builders, with the stipulation that the work was to be completed in 12 calendar months, but was met with the assertion that it was not possible to do it under five years. Whereupon the American manager built them himself, with the aid of native labor, in the time stated. Naturally, this would be expected to serve as an object lesson, and one worthy of emulation, but it did not, for only a few weeks ago the same spirit of delay and inaction prevailed on another building, and every sort of opposite hindrance was opposed to prevent the American contractor from succeeding. Here again is an example of century old prejudices in regard to trade procedure; it matters not that loss and delay attend the operation of them, they are traditional, and that answers the whole argument from the English point of view. Contention might possibly arise between German and British ship and engine builders as to the quality of their work; the author asserts unreservedly that British is the best, but in the last five years German engineers and naval architects have placed the swiftest vessels that navigate the seas, and German marine engines drive them. As to cost, we need not go out of our own country, for Charles Cramp has often asserted that ship for ship we could compete successfully with English yards, so the assertion that English builders rank all others in the production of vessels is an open question.

In any event, however annoying and restrictive specifications may be, they do not cover all the issues in the indictment brought against England's neglect to keep step with progress in the arts, but charges in this direction have been brought so often that they have become uninteresting, and we shall not repeat them here.

Pipe Sizes for Acetylene.[1]

There is a surprising lack of uniformity in the sizes of pipes used for acetylene. In some cases the very smallest of pipes are used in a store or house, and nearby in a building equipped by different parties will be the same size pipes as if coal gas were to be used.

There have been few satisfactory tables, and if they were correct they were usually inconvenient, and seldom recognized the fact that it makes a great difference in the size of pipe whether it is the first or last pipe in the system. For instance, a ½-inch pipe will supply 40 burners at a distance of 30 feet without too great loss of pressure, if that is the end of the pipe system, but if the pipes go on from here and the pressure is already so lowered that there should be no further reduction, then the pipe is too small.

1. By H. C. Earle, in *Acetylene Journal.*

We sometimes hear the pipe question discussed as if there was no loss of pressure if the pipes are large enough for the amount of gas they are to carry, but this is an error, as there is some loss of pressure if any amount of gas is passed through any size pipe for any distance.

In constructing a table of the pipes to be used the first thing is to set a limit of allowable loss of pressure, and then use the formula for flow of gas so that the loss will not go beyond that amount.

The formula used in making this table is

$$V = 1{,}350\ X\ D^5 \sqrt{\frac{D\ X\ P}{G\ X\ L}}$$

in which D is the diameter of the pipe, L the length in yards, P the difference in pressure at the two ends, and G the specific gravity of the gas. In this case G was taken as 0.9.

As we are to make this table answer for all average conditions, we must start with averages of conditions as we find them in practice and will accept the statement of the burner makers that the best results are obtained from the burners with a pressure of 2.3 inches of water. Most of the machines are sent out with a pressure of 2.6 to 2.8 inches, so that there is an allowable drop of 0.3 to 0.5 inch between the generator and the last burner.

Table of Pipe Sizes for Acetylene.

Showing the size of pipe in use to carry the amount of gas at the left, to the distance at the top, with a loss of pressure of 0.04 inch of water in the length of the pipe.

Cubic Feet.	Distance—Feet.													
	10	15	20	25	30	35	40	45	50	60	70	80	90	100
2	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛
4	⅛	⅛	⅛	⅛	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼
6	⅛	⅛	⅛	⅛	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼
8	⅛	⅛	⅛	¼	¼	¼	¼	¼	¼	¼	¼	½	½	½
10	⅛	⅛	¼	¼	¼	¼	¼	¼	¼	¼	½	½	½	½
15	¼	¼	¼	¼	¼	¼	½	½	½	½	½	½	½	½
20	¼	¼	½	½	½	½	½	½	½	½	½	½	½	¾
25	¼	½	½	½	½	½	½	½	½	½	½	¾	¾	1
30	½	½	½	½	½	½	½	½	½	¾	1	1	1	1
35	½	½	½	½	½	½	¾	1	1	1	1	1	1	1
40	½	½	½	½	¾	1	1	1	1	1	1	1	1	1
45	½	½	½	¾	1	1	1	1	1	1	1	1	1	1
50	½	½	¾	1	1	1	1	1	1	1	1	1	1	1
55	½	½	1	1	1	1	1	1	1	1	1	1	1¼	1¼
60	½	½	1	1	1	1	1	1	1	1	1¼	1¼	1¼	1¼
65	½	1	1	1	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼
70	½	1	1	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼	1¼
75	½	1	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼	1¼	1¼
80	1	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼
85	1	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼
90	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1½
100	1	1	1	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½	1½
110	1	1	1	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½	1½	1½
120	1	1	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½	1½	1½	1½
130	1	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½	1½	1½	1½	1½	1½
140	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½	1½	1½	1½	1½	1½	2
150	1¼	1¼	1¼	1¼	1¼	1½	1½	1½	1½	1½	1½	1½	2	2

It is assumed by the coal gas companies that the average house has 8 to 10 sections of pipe in it, and hence we can allow a loss of 0.04 inch in each section, and if there are not over 10 sections the loss from the beginning to the end of the pipes will not be over 0.4 inch.

The first section will be from the generator to the first outlet or branch, the second from here to the next outlet or branch, and has nothing to do with how many pieces of pipe or nipples there may be in this distance.

Each important branch may be taken up in the same way, and the size pipe found from the table, knowing the cubic feet of gas that the pipe should pass and its length.

To illustrate the working of the table: Suppose we have an installation having 40 burners, each ½ foot; this will require, say, 25 feet of gas. The pipe from the generator to the first branch is 30 feet Looking down the column under 30 and in the line of 25 from the left we see ½, which is the size pipe. It will be noticed that this size pipe will carry this amount of gas to a distance of 90 feet before the loss of pressure becomes too great.

If 12 burners have been taken off on this branch we have 28 left, or 15 cubic feet per hour, which is to be carried to some known distance, and from the table this size may be found in the same way.

At the end of the first section the pressure will be 0,04 less than at the

start, and at the end of the second it will be another 0.04 or 0.08 inch of water less, and so on. If there are more than ten sections in the system, as in a hotel, the table may be used by combining some two or more sections and finding the size to use for this as if it was one section, so that there will not be more than ten sections. This will give a size of pipe to use for the combined distance a little larger than might be required for some part of it, and so is safe.

Of course, nothing has been allowed in the table for poor work, pipes full of cement, bends and such things, and if you are doing that sort of work you may allow as much as you think best for that, above the size that will be required if you are doing clean work. Otherwise little judgment is required, and the table is one that will be a help to anyone doing piping for acetylene.

For very large systems, as town plants, the rate of loss here used would be too large, and another table has to be used, with a loss of, say, 0.1 or 0.05 in 1,000 feet.

"The Chief" from an Assistant's Point of View.

By "R. V." in *Electrical Review.*

In these days of severe competition, when the supply of assistant electrical engineers so greatly exceeds the demand, and when the salaries given for their services are so paltry, the necessity arises for the utmost good feeling between them and their chiefs, in order that they may not become disheartened with their positions.

The greatest amount of tact and thoughtfulness is called for on the part of the chief engineer in his relations with his staff. He should endeavor as far as possible to take a personal interest in the work alloted to them in their several departments, but at the same time, if they are capable men, give them a free hand in the work over which they have charge. Where the assistant is young, and perhaps enthusiastic and energetic, he should be encouraged to talk over matters with his chief, and to come to him for friendly advice in any small difficulty that arises.

How often it is that a chief fails to realize the effect on his assistants of a few words of praise or commendation when they have taken some particular pains, or have worked extra hard on some urgent job.

Nothing is so disheartening to an assistant, particularly a young one, as to have no notice taken of him by his chief when he has worked hard, perhaps during many hours of the time that he might reasonably call his own, in order to carry out successfully some special job, or when he has saved his department a considerable amount of money by putting his brains to work and scheming to reduce expenditure on any particular piece of work.

It is the duty of a chief to encourage his assistants in every possible way to throw their whole energy into their jobs, and he should never hesitate to give a meed of praise where praise is due. But at the same time he should not fail to deal with them with a firm hand if they over step the bounds, for by so doing he will earn their lasting respect.

Friction is often caused by the chief "talking over the heads" of his assistants to their men about some job on hand, instead of discussing the matter with the assistants, who are supposed to have entire charge of their gangs. An assistant perhaps tells his men to do a job in a certain way, afterwards comes the chief and tells the men to do it in another way. The assistant then comes back, and finding his men doing the job contrary to his instructions, promptly gets angry when he is met with the unanswerable, "The boss said we were to do it like this." No matter if the assistant had told the men the wrong way to do the job, the chief should have mentioned the matter to him first, except, of course, in a specially urgent case.

In the matter of pupils, too, there is often a considerable amount of ill-feeling. The chief takes the premium, and as a rule, hands the pupil over to the care of his assistants each in turn, and these are supposed to initiate him into all the mysteries of their several departments, to tell and explain to him everything that they have spent years in studying, and, in fact, have to add to their already under-paid jobs and often very onerous duties of technical instructor to a dullard! Is it a wonder, then, that the parents of pupils complain that they don't think that their sons seem to be learning much at their work? What an alteration of the case might be effected if it was the rule, instead of the exception, for the chief to divide, say one-third of the premiums amongst his assistants who have all the trouble and bother of looking after the pupil, and what a lot more practical knowledge the latter would acquire!

In municipal undertakings it is often the case that councilors or committeemen (and these, as a general rule, are totally ignorant of electrical matters) make it their business to spot out imaginary delinquencies in some department, and to report the same at their meetings. The chief is interrogated, and he by the exercise of considerable tact, should be able to refute any imputation on the abilities of his staff. Even if the latter have acted indiscreetly, it is his duty to stick up for them as far as possible before his committee (unless the case be too glaring), and afterwarns to deal with them in a suitable manner. If an assistant feels that his chief has not complete confidence in him, or that he can hesitate in trusting him implicitly, then by far the best thing for him to do is to seek fresh fields and pastures new.

On the other side of the question, an assistant should always bear in mind that the chief is his superior, and should not attempt in any way to disregard him or his position as chief, or do things too much on his own initiative. In important and vital matters concerning his department he should first and foremost go to his chief to consult, and if he has suggestions to offer, listen with patience, to the more matured wisdom of his superior, even if the latter is an inferior superior.

But, in order to do this he must feel that his chief is a man whose experience and judgment are such as to justify his deference, that he knows perfectly what he is talking about, and is capable of giving advice. If there is the least suspicion on the part of the assistant that his chief has had no experience in the matter under discussion and cannot, therefore, grasp the particular difficulties about which his advice is asked, then he naturally loses all respect for him.

In conclusion, the writer is perfectly aware that he has made out a very one sided case, but his apology must be that he happens at present to be an assistant, and such being the case, he awaits someone better qualified than himself to take up a brief for the other side.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. J. A. Mayers has been named to represent, in the East, The Gas Machinery Company, of Cleveland, O. Mr. Mayers is well known in this section through his representation of the Western Gas Construction Company.

The Massachusetts Board of Gas and Electric Light Commissioners has assented to the petition of the owners of the Natick (Mass.) Gas Light Company to issue $20,000 of new stock. The stocks, which is to be issued or sold at the rate of $110 per share, is meant for the purpose of putting the Company in line with its needs for betterments. Superintendent Goulding, it may be depended upon, will make good use of the money, even though the proprietors of the concern were not over quick in their finding that increasing business must have increased capital to obtain the gains.

Mr. Roger Turner, of Paterson, N. J., has been elected a Director in the affairs of the Wallingford (Conn.) Gas Light Company. This concern, which is controlled by Mr. William Barbour, of a well-known New Jersey thread manufacturing company, will make notable main extensions next summer.

A correspondent in Albion, Mich., writing under date of the 29th ult., says: "The Albion Gas and Coke Company has had a prosperous year. It has by an enterprising extension policy, immensely strengthened its popularity with users of gas for fuel and light in our district. It has laid out, since its organization a year ago, not less than $20,000 on the manufacturing and distributing systems. No less than 120 gas ranges were put on the lines last summer."

The Directors of the Troy (N. Y.) Gas Company have elected the following executive officers: President, Edward Murphy, Jr.; Vice-President, William Kemp; Secretary and Treasurer, C. E. Davenport.

Mr. Thomas J. Jones, formerly Vice-President of the Lansing (Mich.) Gas Light Company, has established himself in a general brokerage business at Little Rock, Ark.

The proprietors of the Gloucester (Mass.) Gas Light Company have petitioned the Massachusetts Board of Gas and Electric Light Commissioners for permission to increase the Company's capital stock in the sum of $50,000.

A correspondent in Pottsville, Pa., writes: "Manager Aldrich, of the local Gas Company has touched a popular chord in connection

with his scheme under which houses in the city are being piped for gas at a nominal cost. Hundreds of people have availed themselves of the offer, and the fact is the Company could give employment just now to a score or more of pipe fitters who know their business. The fact is that the German brewery way of getting on no longer applies to the business life of the one-time great anthracite coal city."

MR. CHARLES F. SMITH, at one time Superintendent of Works for the Spanish-American Light, Heat and Power Company, of Havana, Cuba, and formerly connected with the gas plant in Roanoke, Va., died at his home in Lebanon, Pa., the evening of the 25th ult. He was in his 54th year, having been born in Fitchburg, Mass., November 19th, 1849. If we mistake not his connection with the gas industry also included a fairly lengthy period of service with the Lebanon Company.

THE Shippensburg (Pa.) Gas Light Company has named these officers: President, George B. Cole; Secretary and Treasurer, George H. S. McLean.

THE Lawrence (Mass.) Gas Company, in its petition to the Massachusetts Board of Gas and Electric Light Commissioners for the right to issue $200,000 of stock and $100,000 bonds, declares that the proceeds so gained are to be expended in the enlargement of its plant.

A CORRESPONDENT in Toronto, Can., forwards the following: "That the Toronto Consumers Gas Company is doing pretty good business is shown by the reports submitted by its President (Mr. Larratt Smith) at its last meeting. From his compilation it is shown that the output of gas for the year was 1,126,527,000 cubic feet, being 199,778,000 in excess of that of the previous year, and by far the largest increase in the Company's history. That the reduction in the price of gas on January 1st last to 80 cents net would then seem to have been fully justified by the Company's extra business, to use the President's words, is also shown by the fact that the receipts from gas sold during the first 9 months of this year were $855,522.57, an increase of $83,540.17 over the corresponding period of last year. The capacity of the work has almost been reached, says the President, and in the near future he says it is likely that the plant will have to be enlarged. During the present year 2,599 new servicess were put in, and nearly 10 miles of mains laid, making a total of over 277 miles. Referring to the negotiations between the Company and the city with a view to settling all the disputes existing, President Smith says numerous conferences were held, but the Directors found it impossible to come to an agreement, and finally withdrew from all negotiations. A brief account of the city's suit against the Company is then given, followed by this comment: 'It is a source of much gratification to report that judgment was given against the city on every point; to use the language of the learned judge, in his judgment: The action, therefore, appears to me to have entirely failed, and it must be dismissed with costs.' The number of street lamps at present in the city is given as 944, an increase of 21 over the preceded ing year; the number of meters as 33,677, as compared with 30,812 in 1902. The financial statement prepared by Manager W. H. Pearson gives the net receipts as $332,669.16. Out of this $176,630.07 was paid in dividends, $16,223.80 in interest, and $139,815.29 placed in the profit and loss account."

THE proprietors of the Niles (Mich.) Gas Company are proposing to extend the distributing system to the outlying village of Buchanan.

OUR prediction of a week ago, that Mr. William J. Cahill would succeed the late Mr. A. R. Johnson as General Manager of the gas division of the properties of the Utica (N. Y.) Gas and Electric Company, has been verified through official action by the Executive Committee of the Company's Board of Directors. Good luck to him.

MR. JOHN B. ATKINSON has been appointed third member of The Board of Examiners, which body is charged under the law governing the operation of the Louisville (Ky.) Gas Company with the task of determining whether or not the income of the Company is large enough to authorize the Company to make a cut in its selling rates. The other members of the Board are Messrs. R. Montford and W. C. Brohm.

ACCORDING to the Boston (Mass.) *Globe*, of the 1st inst., Judge Braley, of the Supreme Court of that State, involuntarily found for the plaintiff on the demurrers filed by the defendants in the bill brought by George Wharton Pepper of Philadelphia, Receiver of the Bay State Gas Company of Delaware against the Boston Gas Light Company *et al.*, seeking to set aside the sale of the stock of the local Gas Companies by the Mercantile Trust Company in February last on the ground that the sale was the result of a fraudulent and fictitious default on the United Gas bonds. The court suggests certain amendments to be made by the plaintiff, which, if done, will overcome the objection of the defence to the bill on the ground of multifariousness. The question of non-residence, the court holds, does not affect the jurisdiction of the court as to trust property now within its jurisdiction. As to the objection of laches on the part of the plaintiff the court holds to the contrary. If the amendments as suggested are made before Nov. 16 the demurrers are to be overruled; if not, they are to be sustained.

THE Springfield (Mass.) Gas Light Company proposes to extend its mains to the outlying village of Indian Orchard.

A CORRESPONDENT incloses the following: "Mr. Jules H. Wittich has resigned from the service of the Municipal Electric Light Department, Alameda, Cal. The authorities seem to be unable to keep a good man in their service any length of time that would seem reasonable to those who conduct business on ordinary account.—A. R. W."

THE proprietors of the Parsons (Kas.) Gas Company seem to have reached the point of wisdom that hints that main extensions would be profitable.

MR. F. R. HOYT, who thought he was going to revolutionize the gas industry in Mexico, did not do so. He is back in New York.

THE stockholders of the Consolidated Gas and Electric Company, of Batavia, N. Y., at a meeting recently held voted to increase the capital stock of the Company from $200,000 to $300,000. This vote was unanimous, 1,789 out of 2,000 shares being represented. R. C. Garhart of New York, C. O. Lawton of Boston, and Rev. G. D. Miller of Rochester, were the out-of-town stockholders present. Only a portion of the authorized increase of stock will be issued at present. Subscriptions for $25,000 worth at par, $100 a share, have been received. A resolution was adopted to-day whereby no stock will be sold below par.

THE D. M. Steward Mfg. Company notified us that they have discontinued their branch office in Chicago, formerly located in the building on 57 Washington street.

THE Five Mile Beach Gas Company, to supply gas to Holly Beach City, N. J., has been incorporated by Messrs. J. W. Morgan, of Camden, H. H. Voorhees, F. C. Mayer, L. O. Smith, Augustus Nelson, Fred. Slater, W. J. Patton, Carl Erickson and E. S. Kilmer, of Holly Beach.

A NEW selling schedule is to be put in force by the Sag Harbor (L. I.) Gas Company by December 1st. All the details thereof have not been completed.

THE Commissioners of the District of Columbia have received from Mr. Walter C. Allen, the District electrical engineer, his report regarding the operations of his department for the fiscal year ended June 30 last. During that time the work of changing the system of arc lighting from the old style open series lamps to those of an inclosed type was completed. The number of such lamps in operation at the close of the year was 584 inclosed series lamps and 381 inclosed multiple lamps. The service has been greatly improved by this change, the number of lamps reported out being considerably reduced. The contract for naphtha lighting was awarded to the American Development Company at the rate of $19.65 per annum. No contract for 60-candle power mantle incandescent lamps was awarded. To this report is appended tables showing the number of street lamps erected and maintained and their locations. During the year there have been added 1,013 new lamps of various sorts, and 486 have been discontinued. Tables are submitted showing the number of lamps maintained by the various companies, gas, electric, and naphtha. A table shows the amount of work done in the matter of erecting telephone wires and poles and the laying of the underground system. Mr. Allen detailed the total space occupied by District cables. Three signal circuits were added to the 21 in service on July 1, 1902. Fifty fire alarm boxes were purchased with the special appropriation made for that purpose, and 24 of them placed in service. Eight fire alarm boxes were purchased and installed at cost

(*Continued on page* 734.)

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

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NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, NOVEMBER 9, 1903.

(*Concluded from page* 733.)

for private parties. Mr. Allen detailed the additions that had been made to the District telephone system and the police patrol system. The electric wiring and devices in each of the 7 theaters were inspected during the summer. This inspection was in addition to regular weekly visits made at each theater during the theatrical season (usually Monday and Tuesday evenings during the performances), in order to insure the safety of the various electric devices carried by the various traveling companies."

THE extensions to the plant of the Hannibal (Mo.) gas plant are to be carried out under the planning and direction of Mr. B. E. Chollar.

THE Swedesboro (Pa.) Gas Company will extend its main system to the adjoining town of Woodstown.

In the Natural Gas Belt of Kansas.

Prof. G. P. Grimsley, State Geologist and Secretary of the Kansas Academy of Science, has issued an official pamphlet, entitled "Oil, Gas and Glass, Chemical Industries and Minerals of Kansas." The pamphlet is illustrated with diagrams showing the belts in which the principal deposits of oil, gas, bituminous coal, lead, zinc, gypsum and salt are found. Oil and gas are distributed through nine counties in the southeastern part of the State, running southward into Indian Territory. Analyses of the gas show that it averages 94½ per cent. in marsh gas (CH_4) with entire freedom from sulphur and sulphuretted hydrogen, and less than 1 per cent. of non-combustible impurities. Strong claims are also made for the quality of the oil produced by the 700 wells now in operation.

The following values are given of the annual productions in the State of the industries named:

Coal mines	$6,799,563
Gas wells	800,000
Oil wells	360,357
Salt wells	762,609
Gypsum plaster mills	209,172
Hydraulic cement mills	1,556,490
Sandstone quarries	529,157
Brick yards	1,200,000
Lead and zinc mines	1,403,724

Inasmuch as natural gas is the ideal fuel for fluxing the materials that go into the manufacture of glass, the leading glass works of this country are now located in the natural gas belts of Indiana and Ohio. The rapidly decreasing supply of natural gas in these States and the presence in the natural gas belt of Kansas of silica sand, salt and lime have already led to the removal of several glass works to Kansas. Others will follow in proportion to the success of the Kansas plants. Cement and gypsum plaster mills constitute one of the largest industries of the gas belt of Kansas, the plant at Iola being, it is claimed, one of the largest in the country.

The Market for Gas Securities.

There is nothing of importance to chronicle in gas stock trading since last time of writing, notably in respect of Consolidated which is dull and strong. Quite a bit of a short interest exists in it that has not been covered, and from indications the covering will be made at a point or points much higher than those quoted to-day (Friday). The transferring in Consolidated has been remarkably light since the last "rights" were exercised. It should sell at 200 before January 1st. The demand for city gas bonds continues in a quietly persistent sort of way.

Brooklyn Union is 195 bid, or a nominal gain of 15 points for the week. From its volume of business, its freedom from collateral debts and its power to increase either its capital or trading, the stock is not worth anything if it is not worth 250. Peoples, of Chicago, continues in good demand, and a like remark applies to Consolidated, of Baltimore. Cincinnati gas and electric is somewhat lower than the situation would there seem to warrant. At the reported figures it looks a purchase.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

NOVEMBER 9.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$78,177,000	100	176	178
Central Union, Bonds, 5's	3,000,000	1,000	104	106
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan	658,000	..	108	112
Mutual	8,500,000	100	280	295
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.. Bonds, 5's	11,000,000	1,000	103	105
Northern Union, Bonds, 5's	1,250,000	1,000	105	106½
New York and East River Bonds 1st 5's	3,500,000	1,000	102	106
" 1st Con. 5's	1,500,000	..	109	111
Standard	5,000,000	100	135	140
Preferred	5,000,000	100	155	170
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	193	205
" " Bonds (5's)	15,000,000	1,000	119	119½
Bay State	50,000,000	50	⅛	¼
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	4	5
" " Bonds, 5's	5,250,000	1,000	73	76
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	92¼	92½
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89½
Preferred	3,026,500	100	107½	109
Consumers, Jersey City Bonds	600,000	1,000	100	102
Consumers Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	62½	63
Mortgage, 6's	3,600,000	..	..	115
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	119
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	86	90
Consolidated G. & E. Co.'s. Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	87	95
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	362,000	1,000	77	79
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	15	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,255,000	1,000	104½	105
Hartford	750,000	25	245	255
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	50	65
" Bonds, 6's	2,650,000	..	103½	106½
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	79	90
Preferred	2,500,000	100	86¼	..
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	136	140
Madison Gas & Elec. Co. " 1st Mtg. 6's	250,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	184¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	220	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	93¼	93¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	15,800,000	100	67	67¼
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	93	96½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	113½	115
General Mortgage, 5's	2,465,000	1,000	92	94
Syracuse, N. Y.	1,975,000	100	46	48
Bonds	2,047,000	1,000	94	96
Washington, D. C	2,600,000	20	295	297½
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	.	..	..
Wilmington, Del.	600,000	50	252	..

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Position Wanted

With a Gas Company in Northern New York,

By a practical gas engineer having good references. Also, has a knowledge of civil engineering. Will guarantee to place gas company's business on a paying basis.

1483-1 Address, "M. F. G.," care this Journal.

Situation Wanted.

EXPERIENCED MANAGER, thoroughly familiar with every depar ment of the business, coal or water gas. Successful in economical operation and development of new business. Can guar ntee results. Energetic and progressive. Good record.

Address, "DIVIDENDS,"
1476-8 Care this Journal.

Situation Wanted

As Manager or Superintendent of Small Coal or Water Gas Plant,

By a man 45 years old. Successful and economical in operation and up to developing new business. Thoroughly practical and experienced in all branches. Progressive. First-class references given. Address, "S.,"
147?-tf Care this Journal.

Position Wanted

BY A YOUNG MAN 25 years of age; seven years' experience with gas companies. Has had good experience in laying mains and services; gasfitting work of any description; complaint work, meter reading and meter setting. Also, handy at drafting. Best of references.

1488-1 Address, "H P.," care this Journal.

Position Wanted.

A GAS ENGINEER, of great ability and experience in constructing and operating gas plants, here and abroad, is now open for an engagement.

1483-1 Address, "MODERN," care this Journal.

WANTED,

A Competent Meter Repairer.

Permanent employment. Apply, giving references, to the LAFAYETTE GAS CO.,
1480-4 LAFAYETTE, IND.

WANTED,

A Competent Gas Maker for Lowe Apparatus,

By a gas company in Western Illinois. Apply, giving references and salary expected, to

1476-tf "GAS MAKER," care this Journal.

WANTED,

SECOND-HAND GASHOLDER,

Twenty five thousand to 40,000 cubic feet capacity. Purchaser will remove.

Address, "CONSTRUCTOR,"
148?-2 Care this Journal.

FOR SALE.

Four Sections of Wrought Iron Hydraulic Main, Stiness Patent Tar Take-Off; Bridge, Standpipes and Mouthpieces, with **Self-Sealing Lids** for 7 benches of 6's.
One Sinuous Friction Condenser.
One Walker Tar Extractor.
One Standard Scrubber.
Four Purifiers, 10 by 16, complete.

All of the above apparatus is in good condition and to be sold as the Company have been obliged to purchase larger for their new works. Address,

TAUNTON GAS LIGHT CO.,
148?-6 TAUNTON, MASS.

FOR SALE—CHEAP.

Four Purifiers, 8 by 8 by 3 feet, for 8-inch connections.
One P. & A. Tar Extractor, 8 inch connections.
One 6-Inch Steam Jet Exhauster.
Six 6-Inch Gate Valves.

All of the above are in good condition and will be sold at a low figure. Address,

LANSING GAS LIGHT CO.,
1482-3 LANSING, MICH.

FREDERIC EGNER,
Gas Engineer,
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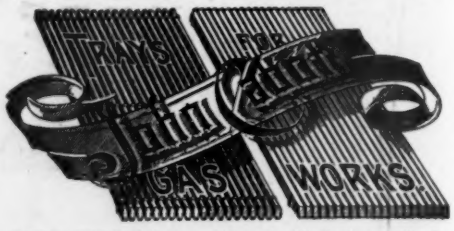

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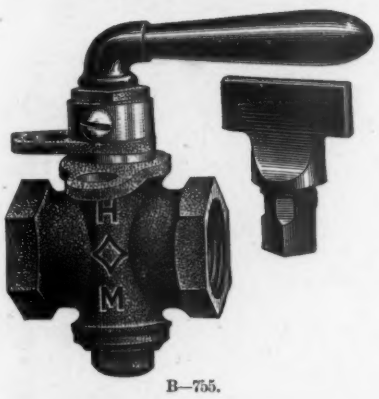

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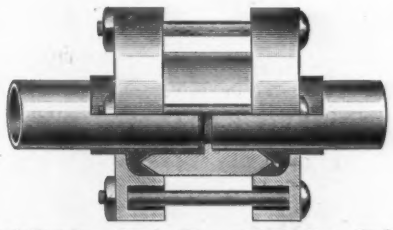

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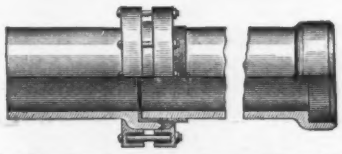

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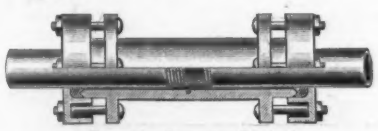

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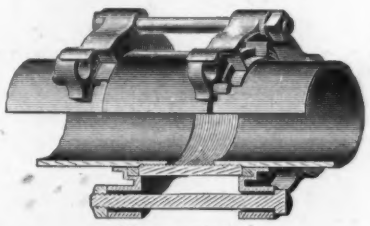

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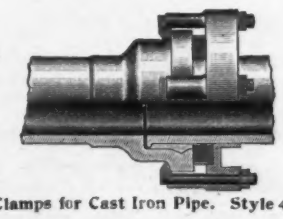

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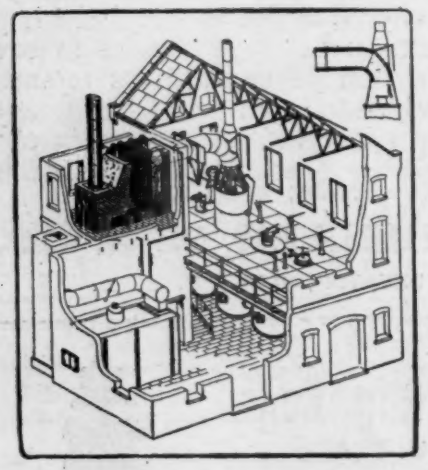

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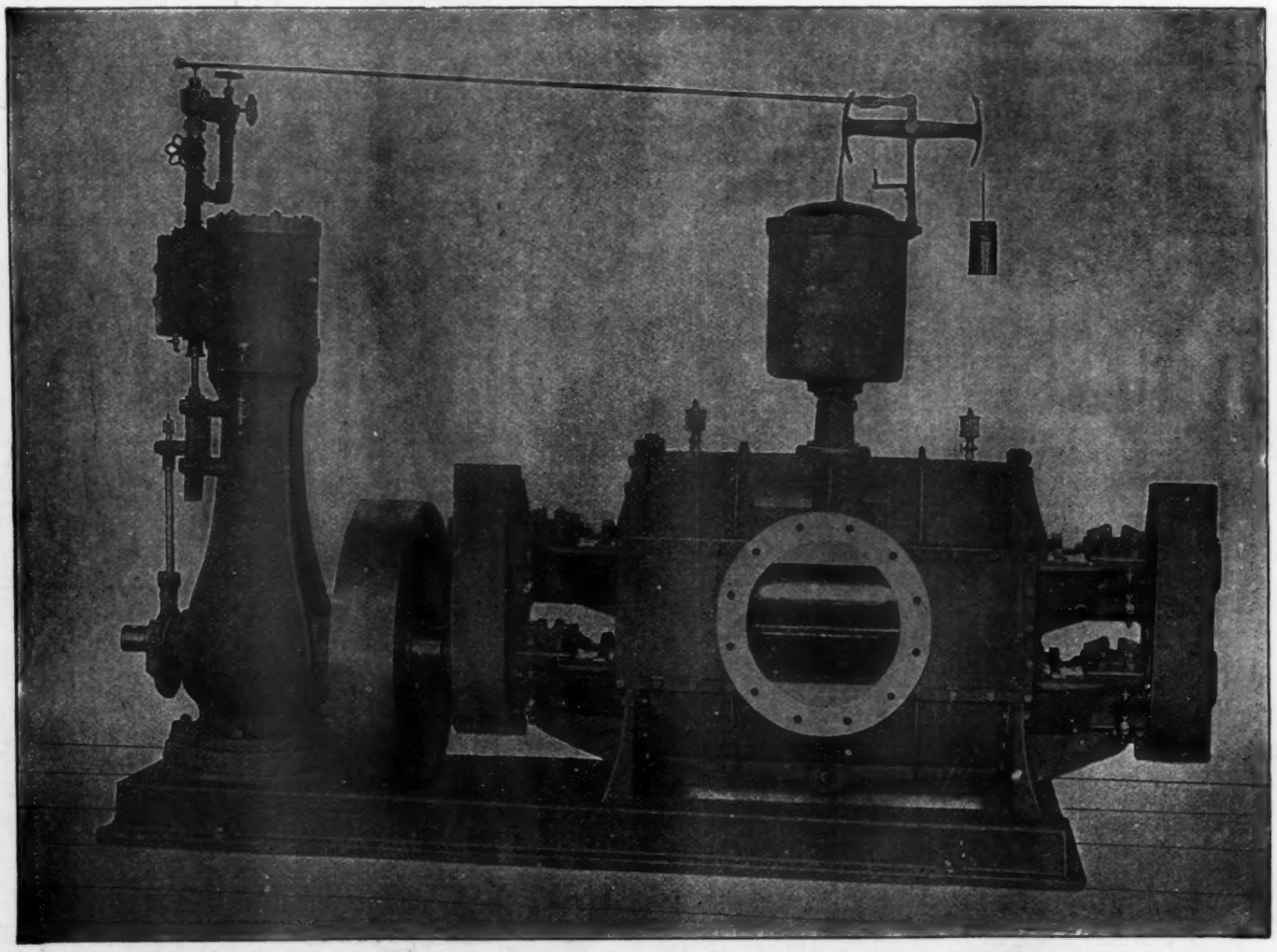

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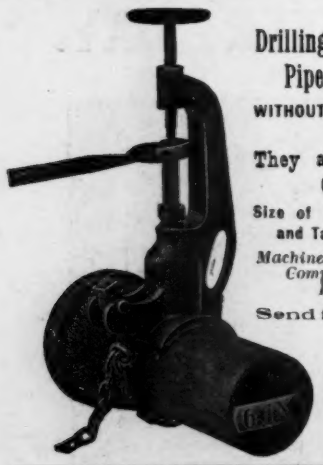

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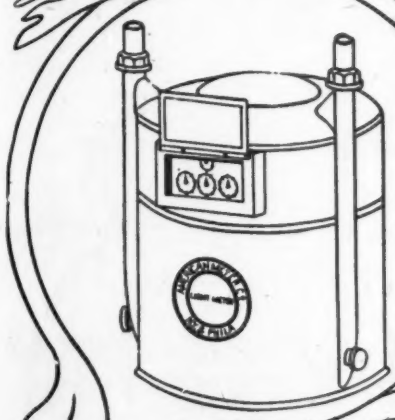
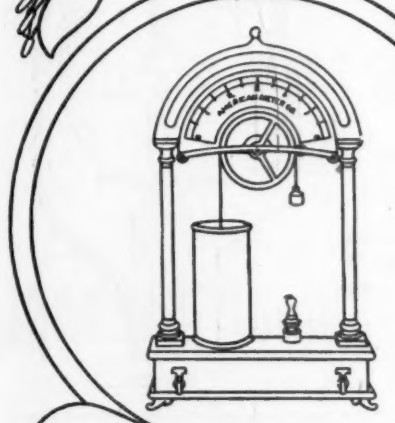
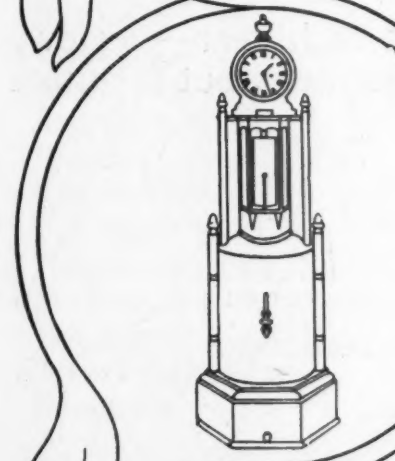
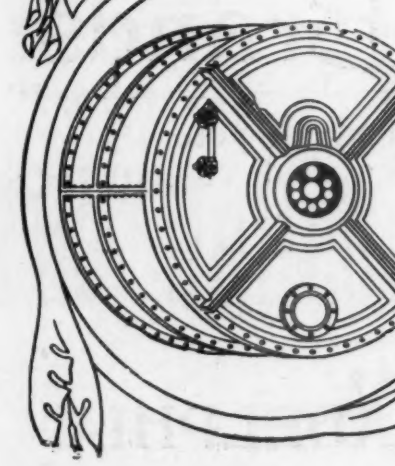




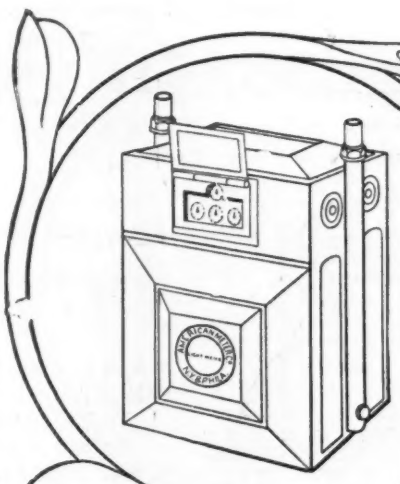


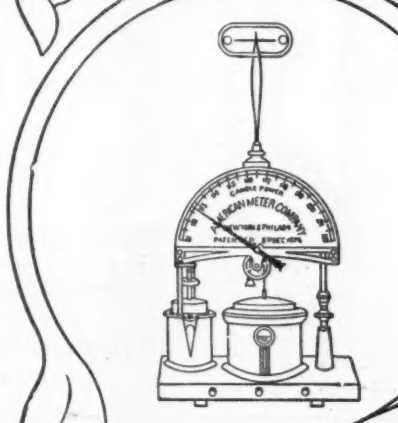


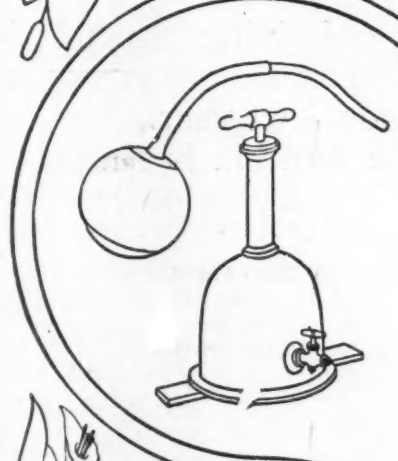
PUBLIC LIGHTING TABLE.

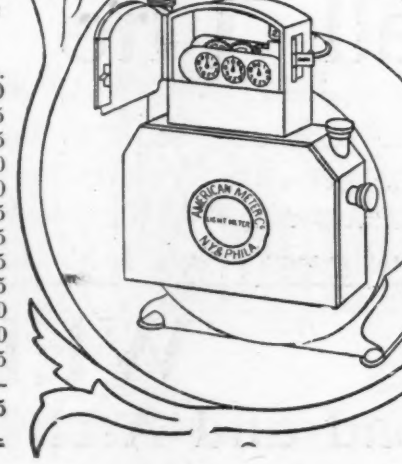
NOVEMBER, 1903.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Sun.	1	2.40 AM	5.30 AM	4.45	5.35
Mon.	2	3.40	5.30	4.45	5.35
Tue.	3	No L.	No L.	4.45	5.35
Wed.	4	No L. FM	No L.	4.45	5.35
Thu.	5	No L.	No L.	4.40	5.45
Fri.	6	5.20 PM	7.20 PM	4.40	5 45
Sat.	7	5 20	8.10	4.40	5.45
Sun.	8	5.20	9.10	4.40	5.45
Mon.	9	5.20	10.10	4.40	5.45
Tue.	10	5.20	11.10	4.40	5.45
Wed.	11	5.20 LQ	12.20 AM	4.40	5.45
Thu.	12	5.20	1.30	4.30	6.00
Fri.	13	5.20	2.40	4.30	6.00
Sat.	14	5.20	3.40	4.30	6.00
Sun.	15	5.10	5.50	4.30	6.00
Mon.	16	5.10	5.50	4.30	6.00
Tue.	17	5.10	5.50	4.30	6.00
Wed.	18	5.10 NM	5.50	4.30	6.00
Thu.	19	5.10	5.50	4.25	6.00
Fri.	20	5.10	5.50	4.25	6 00
Sat.	21	5.10	5.50	4.25	6.00
Sun.	22	5.10	6.00	4.25	6.00
Mon.	23	7.40	6.00	4.25	6.00
Tue.	24	8.40	6.00	4.25	6.00
Wed.	25	9.30	6.00	4.25	6.00
Thu.	26	10.30 FQ	6.00	4.20	6.10
Fri.	27	11.30	6.00	4.20	6.10
Sat.	28	12.20 AM	6.00	4.20	6.10
Sun.	29	1.20	6.00	4.20	6.10
Mon.	30	2.20	6.00	4.20	6.10









TOTAL HOURS LIGHTING DURING 1903.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	245.00	January	423.20
February	192.00	February	355.25
March	201.00	March	355.35
April	167.20	April	298.50
May	152.00	May	264.50
June	131.00	June	234.25
July	140.40	July	243.45
August	156.20	August	280.25
September	171.20	September	321.15
October	198.20	October	374.30
November	216.30	November	401.40
December	232.10	December	433.45
Total, yr.	2203.40	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 814 Beacon Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

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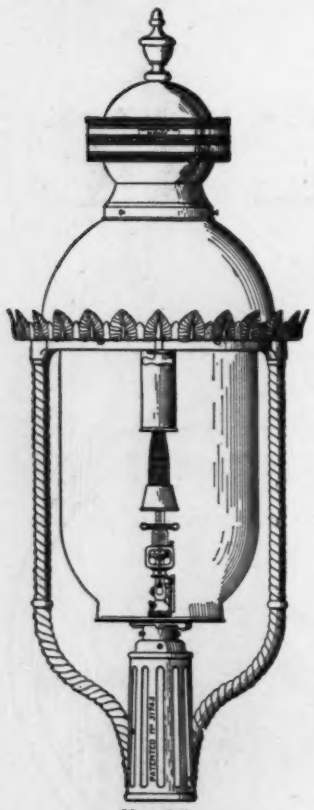
.... OF AMERICA ....



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Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

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The formula is simple-

THIS SHIELD IS THE WELSBACH TRADE MARK.

IT IS A GUARANTEE AND A PROTECTION.

Sell The Welsbach Brands.

The imitation stuff is bad for the customer---which is bad for you.

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And your profit isn't merely dollars and cents.

WELSBACH CO.,

Broad and Arch Sts., PHILADELPHIA.

THE UNITED GAS IMPROVEMENT COMPANY

For the Months Ending October 15, 1903, has been Awarded Contracts in the Following Places for

Standard Double-Superheater Lowe Water Gas Apparatus.

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Baltimore, Md.	**Chester, Pa.**	**Savannah, Ga.**
Chicago, Ills.	**Lynn, Mass.**	**New York** (Central Union Co.)
Amesbury, Mass.	**Newark, N. J.**	**Cicero, Ills.**
Aberdeen, S. D.	**Washington, D. C.**	**Chicago** (Ogden Co.)
Winsted, Conn.	**Boone, Ia.**	**Easton, Pa.**
Canon City, Col.	**Pueblo, Col.**	**Lawrence, Mass.**
Schenectady, N. Y.	**Charlotte, N. C.**	**Council Bluffs, Ia.**
Hagerstown, Pa.	**Fall River, Mass.**	**Chattanooga, Tenn.**
Malden, Mass.	**Duluth, Minn.**	**Tuckerton, N. J.**
Bridgeport, Conn.	**New York** (Mutual Co.)	**Springfield, O.**
Albert Lea, Minn.	**Waltham, Mass.**	**Easton, Pa.** (2d contract).
Brooklyn, N. Y.	**Dover, Del.**	**Mobile, Ala.**

TOTAL DAILY SETS TO OCTOBER 15, 1903, ... 55
TOTAL DAILY CAPACITY, ... 56,600,000 cubic feet.
TOTAL SETS TO DATE, ... 502
TOTAL DAILY CAPACITY, ... 356,280,090 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
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Fire Brick, Tiles, Etc.

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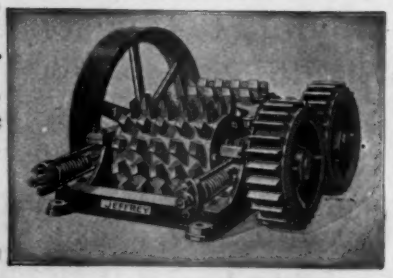

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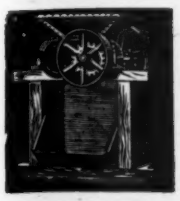

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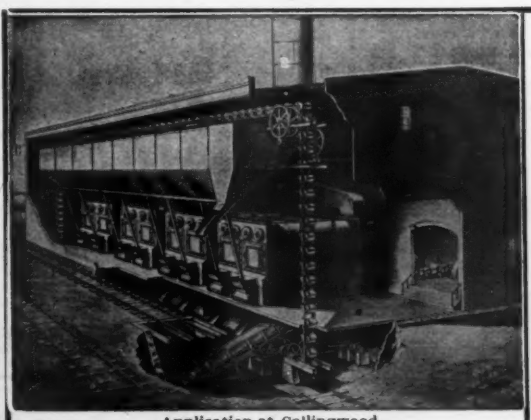

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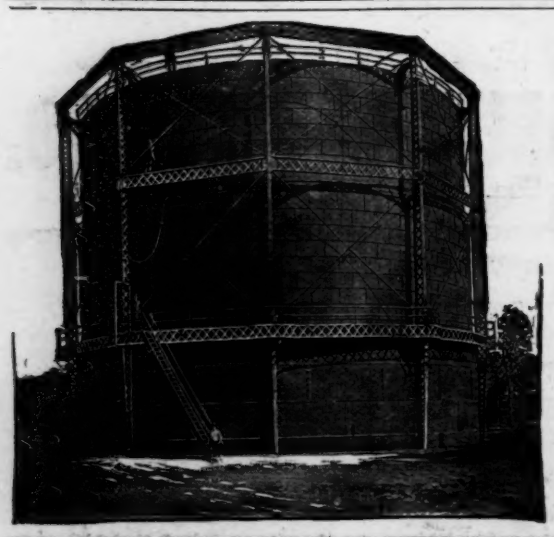

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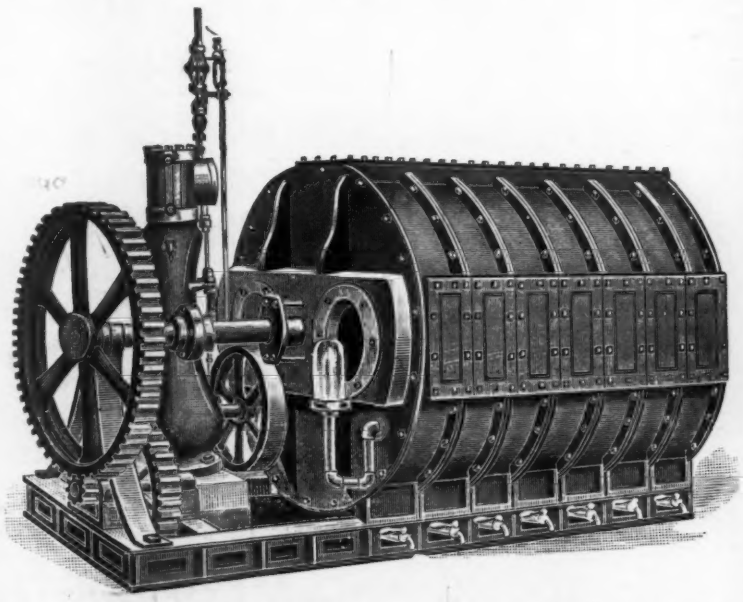

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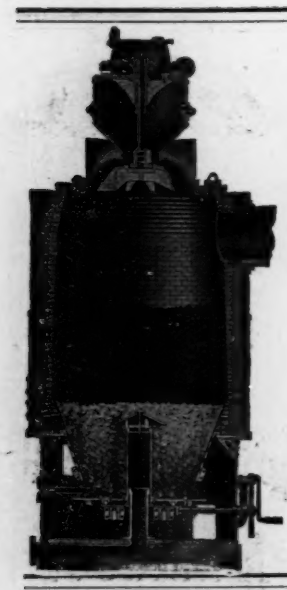

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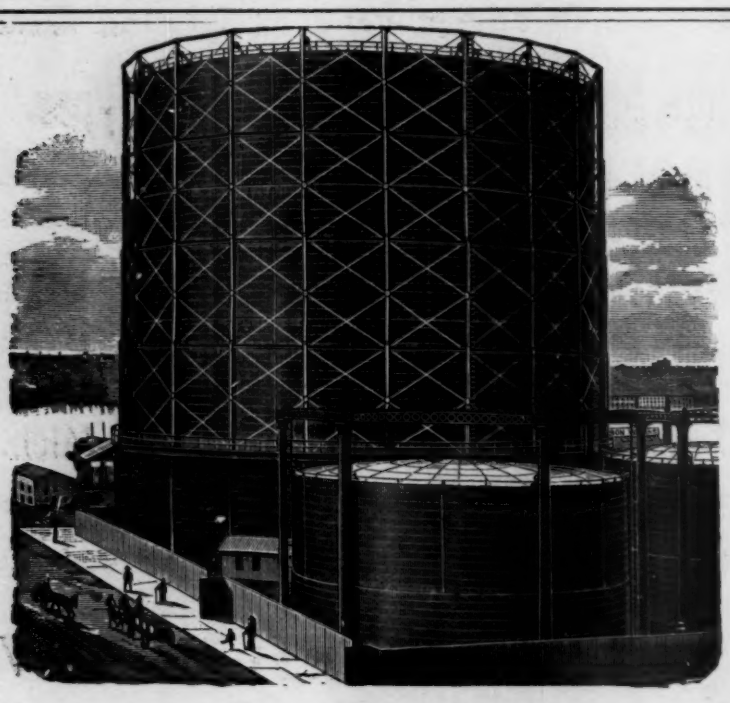

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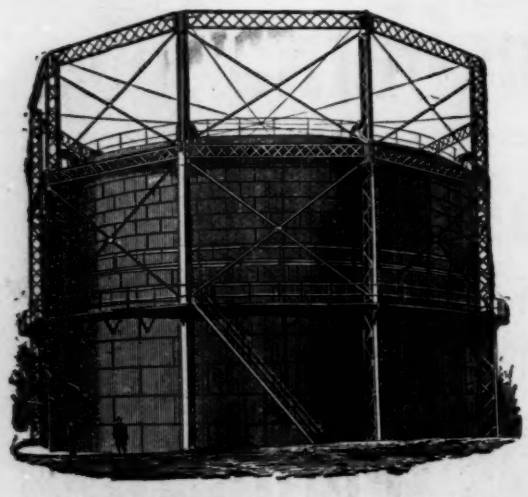

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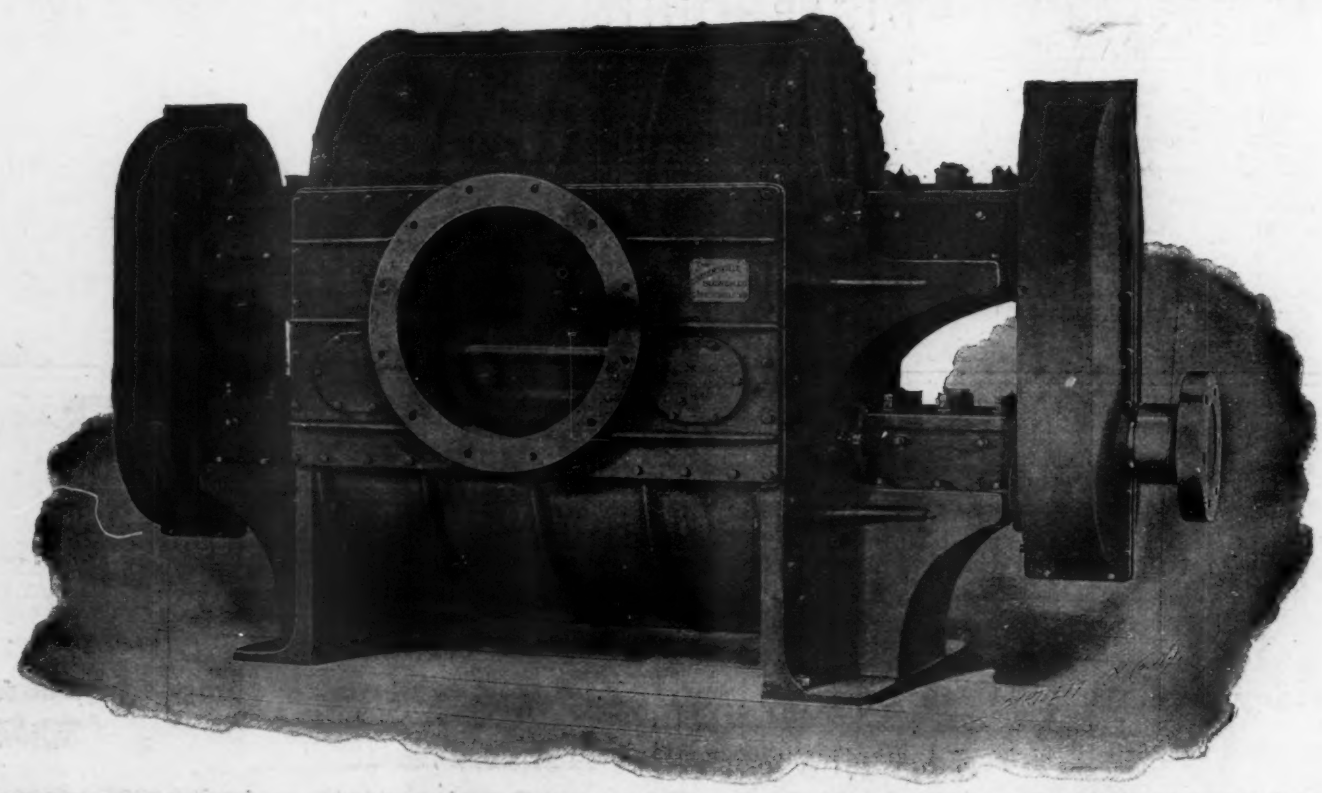

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